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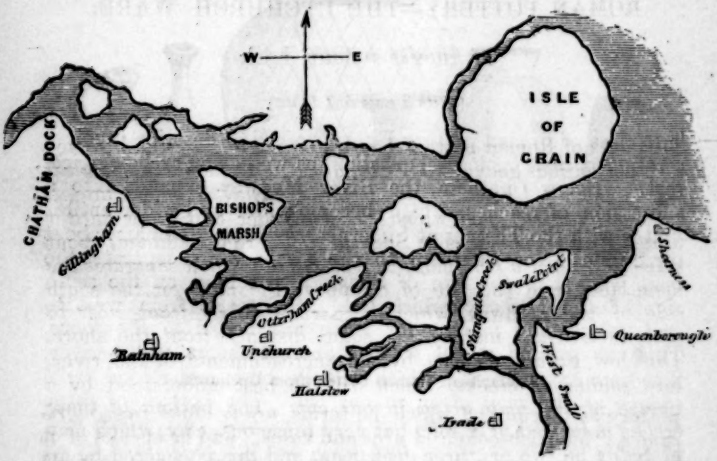
ROMAN POTTERY—THE UPCHURCH WARE.

BY THOMAS WRIGHT, F.S.A.

(*With a Coloured Plate.*)

THE class of Roman pottery I now proceed to describe involves a rather curious geological question, as well as an archæological fact. Below Chatham, the River Medway expands into a succession of reaches, which become wider and wider until it unites with the Thames at Sheerness. From Rainham, about three miles below Chatham, to the Swale, which separates the main land from the Isle of Sheppey, the land on the south side of the Medway, which here runs nearly from west to east, is low and marshy for some distance from the shore. This low ground is cut, by the encroachments of the river, into numerous creeks, which will be best understood by a glance at the map given in our cut. The bottom of these creeks is formed of a soft, but very tenacious, clay, which may probably be two or three feet deep, and this is covered by an accumulation of from two to three feet of soil. In the clay we find at a slight depth a continuous deposit of Roman pottery, almost all either broken or defective, mixed with the remains of burnt fuel from the kilns, and attended with other circumstances, which leaves no room for doubt of their being the refuse of extensive Roman potteries. We may judge, indeed, of their extent from the fact that they reach along the river from Rainham to the Swale, between five and six miles, and inward, on an average, from a mile to a mile and a-half. The greater portion of this low ground is divided into the Upchurch Marshes and the Halstow Marshes, named from the two parishes over which they extend. This bed of pottery is nowhere seen to more advantage than in Otterham Creek, in the former parish, which winds up to near Upchurch church. To

explore this creek with any success, you must enter it with a boat at low water, when a large extent of clay is left uncovered on each side the water, which you can only walk upon, or rather into, with long waterman's boots, and you soon reach the layer of pottery underneath by means of a stick, or, which is the more effective method, by thrusting your hand and arm into the clay, when you may pull up almost as much pottery as you like. As the pottery was first observed and examined here, it has been called by antiquaries Upchurch Ware, though the Roman potters' works extended over several parishes. The pottery is no less abundant in the creeks and dykes of the Halstow marshes, from Otterham Quay to Stangate Creek, but



Map of the Upchurch and Marshes.

these localities are of less easy access than Otterham Creek. There can be no doubt, not only from the extent of ground covered by the potteries, but from the frequent occurrence of the sort of pottery made here, among Roman remains in Britain belonging to different periods, that these potteries were in full activity during the whole extent of the Roman period. The site of the kilns was moved as the clay was used up, and at the same time the refuse pottery was thrown on the ground behind them, so that, when at last abandoned, this extensive site presented a surface of ground covered almost entirely by a bed of refuse pottery. It would seem that, to produce its present appearance, the ground must have sunk, so

as to be covered with water, which perhaps deposited a new bed of clay, and that after this it must have become raised again, to receive its surface of soil, since which the water of the river has trespassed upon the ground in its new elevation, and formed the creeks as they now appear; and, though possibly the state of the ground may be explained otherwise, yet it is well worthy of consideration in connection with the interesting question of the change of the coast level.

The existence of these Roman potteries is not altogether a modern discovery. Dr. Battely, whose *Antiquitatis Rutupinæ*, or Antiquities of Richborough, was written before the beginning of the last century, had observed the remains of this

7 6 5 4 1 3 2 8 9

Examples of Roman Pottery from Upchurch.

pottery at Upchurch, which he terms *urnas atque vasa nigricantes*, "blackish-coloured urns and vases," and he speaks of it in that book, giving it as his opinion (in which he was correct) that the locality in which they were found was not a Roman cemetery, but the site of Roman potteries. The antiquaries of the last century, and of the earlier part of the present, neglected or despised the information given by Battely; and Halsted, the well-known historian of Kent, actually discredited the notion that such pottery had ever been found there. We owe our first knowledge of the full truth to our distinguished antiquary, Mr. Roach Smith, who has given interesting accounts from his own personal observation in the *Journal of the British Archæological Association*, and in his *Collectanea Antiqua*,*

* See the *Journal of the British Archæological Association*, vol. ii., p. 134, July, 1846; and Roach Smith's *Collectanea Antiqua*, vol. vi., p. 173, 1864. Mr. Roach Smith had first called attention to this pottery in 1840, in a communication to the Society of Antiquaries, printed in the *Archæologia*, vol. xxix., p. 223.

from which I take much of the information contained in the present article.

The Roman ware made in the Upchurch potteries presents distinctive peculiarities which cannot be mistaken, and it must have been in great repute, certainly the next after the foreign Samian and the native Durobrivian wares, in this province of the empire. Like the Durobrivian, too, it has been found, I believe, on Roman sites in France and Germany, so that it was probably exported. As Battely has described it, the greater proportion of this ware is of a "blackish colour," or rather of a bluish or greyish black, which was produced, no doubt, by the process of the smother-kiln, already described in our paper on the Durobrivian pottery. Some of the Upchurch pottery presents a colour approaching to dark drab. Examples of both are given in our plate. The forms, as well as the sizes, vary greatly, but they all present those delicate forms of the curve which we recognize at once as coming from the hands of the Roman artist. The texture of the pottery itself is fine, and it is very thin. The ornamentation also is varied, but not very elaborate, or very refined. One of the most elegant patterns is represented in the first figure in our plate. It consists of a band of half-circles, made with compasses, from each of which a band of parallel lines descends vertically. Another example of this class of ornament is given in one of the groups (2) in our accompanying woodcut. A pattern different from this, but still presenting some of the same characteristics; is shown in the lower figure to the left on our plate. This, again, both in form and in the character of its ornament, though it is more simple, may be compared with No. 4 in the cut. The little vessel (3) in the front of the cut has had two handles, but one is lost: it is supposed to be an incense pot.

The instruments used in the ornamentation of this pottery appear to have been of a very rude description, and were, as it seems, chiefly mere sticks, some sharpened to a point, and others with a transverse section cut into notches. The former were used in tracing the lines already described; the latter had the section formed into a square, or rhomboid, the surface of which was cut into parallel lines crossing each other, so as to form a dotted figure, and this was stamped on the surface of the pottery in various combinations and arrangements. An example of this description of ornament is given in the upper vessel to the right in our plate. Sometimes these dots are arranged so as to form bands, as in the example in the back of the group in the woodcut (5). The middle figure in our plate represents another ornament, which is more difficult to describe, but which is not uncommon. The large urn in the middle of our group in the woodcut (1) furnishes an example

of another kind of ornamentation found on the Upchurch pottery, formed by parallel intersecting lines. In its shape, this vessel has much the appearance of a sepulchral urn. A considerable quantity of this pottery is without ornament at all. Among this unornamented pottery are found especially jug-shaped vessels, commonly with a handle, like that represented in the last figure in our plate. Two similar vessels are represented in our woodcut (8 and 9); in which I give also a curiously-shaped plain urn (7), and an unornamented vessel of another form (6).

At different spots over the locality which was covered by these potteries, Mr. Roach Smith has found remains which indicate the former existence of kilns, and further researches will most probably bring to light some of the kilns themselves. Traces have also been found of the residences and of the graves of the potters. There appears to have been a more extensive settlement—a potters' village, or little town—on the higher ground, bordering the marshes at Halstow. "In the Halstow marshes," Mr. Roach Smith observes, "I noticed, at a particular spot, a considerable quantity of tiles and stones, which I could not positively identify as having been used in buildings; but adjoining the church, near the creek, there are abundance of fragments of tiles of various kinds, that clearly show the locality to have been the site of buildings, which, if we may judge from their *débris*, must have been tolerably extensive. On the sides of the church, facing the creek, an embankment has been thrown up to protect the land from the sea; this defence is filled with broken tiles and pottery, which also literally cover the shores. The church itself, probably of Saxon origin, has a large quantity of Roman masonry worked into the walls, and in a field west of the church, in the side of a well sunk for water, for purposes of brick making, I noticed a tier of Roman tiles, which appeared to be part of a hypocaust."

CHACORNAC ON THE VOLCANOES OF THE SUN.

We have, in former numbers, made mention of M. Chacornac's solar observations at Ville-Urbanne, and of the theories which he has been led to form, and we are now indebted to him for a long paper on "The Structure and Origin of Solar Volcanoes." In the present condition of the sun, in which the production of spots is at a minimum, he informs us that the time is favourable for the study of *little spots* which frequently appear entirely destitute of a penumbra so long as their largest dimensions do not exceed five or six seconds of an arc, but which acquire one as they grow bigger. Referring to earlier observations, M. Chacornac informs us that he has drawings of 740 isolated spots not exceeding the dimensions just stated, and all destitute of any certain traces of a penumbra; while other spots, in closer aggregation or united by fissures, usually exhibit a portion of a penumbra generally corresponding with that part of the spot which is darkest and most deeply excavated. In this category must not be comprehended simple superficial fissures, which are themselves only isolated penumbra, and which appear of different degrees of shade from the intensity of certain nuclei to that of the general surface of the orb, or about a sixtieth below the surface. These are only variations in the level of the photosphere, and seem to occur in the most external layers of the immense luminous envelope of the sun. The causes which produce them appear to reside in the superficial layers, as it is only changes in the layers which underlie the photosphere that can give rise to such phenomena, and this fact, taken in connection with the rapid changes of form that are noticed on the solar surface, leads to the conclusion that we have to do with an immense atmosphere enveloping a central nucleus.

The phenomenon which should occupy the foremost place in any hypothesis is without doubt the rapidity of the precipitation of spots one in the other. Hence comes the relative movements of groups in different latitudes, and the appearance of fusion which characterises the formation of spots. All astronomers, for example, might remark the regular form of the great spot which entered the visible hemisphere during the night of the 7th—8th of last July, and the persistence of this form, which was nearly circular and without diminution, all the while the spot appeared, which was up to the 20th July at 6 P.M.; and they could also notice the irregularities of shape and the rapid changes exhibited by a single group which occupied the centre of the disc on the day last named.

The very rapid changes in this last group, M. Chacornac

thinks not consistent with the supposition of a liquid medium. It was evidently a cloudy or gaseous one, able, by sudden condensation, to form a relative vacuum, and occasion the precipitation of fresh atmospheric layers upon the photosphere, and the consequent formation of spots. Spiral gyratory movements indicated this kind of action. Moreover, the spots exhibited a disposition more or less striking to form gulfs, into which the photospheric matter descended.

In order to have superficial currents in a fluid spherical mass, it seems necessary that there should be a break in the decreasing density of its layers, and that there should be an abrupt transition, as in the case of the atmospheres of Jupiter, Saturn, or the Earth, which rest upon a solid surface, and likewise a cause for the variation of the temperature of its layers. From these and other considerations, M. Chacornac concludes that it is an atmosphere with which our observations have to do.

The nuclei, in which great and feebly-luminous depths are seen, disappear as if by evaporation—they dissipate themselves like atmospheric clouds. The same phenomena are exhibited in deep as in superficial layers, and who does not see in this order of facts an explanation of the immense cavities into which faculæ are precipitated in torrents. Nothing is more simple than these fusions and rapid falling of little spots into big ones. In the region in which a vacuum is made, that is to say in a spot, the cloudy layers are precipitated in the liquid form on to the surface of the central body, or perhaps these vapours in a vesicular state are vaporized and dissolved so as to occasion a vacuum in which the superior or adjacent layers are swallowed up.

M. Chacornac observes that the descending currents in these cases must have great force to draw with them, as he has seen, matters possessing a horizontal velocity of 550 mètres in a second.

The mobility of the spots and the rapidity of their changes are regarded by M. Chacornac as opposed to the conception of a resisting medium, and still more so to rents in a solid crust.

When a great spot is forming, all the surrounding parts are dragged into the gulf, into which also fall adjacent spots of small dimensions.

If a spot is solitary it assumes the regular form of a funnel, and the flocculent matter is distributed in channels round the whirlpool orifice (*orifice turbiné*).

M. Chacornac does not deny the existence of ascending currents, though what is observed only proves the operation of descending currents. All spots, for example, are cavities

with the narrow orifice downwards, and the forms of streams and ripples (*sillons*) of flocculent matter always indicate a descent of the upper layers into the regions below.

When a funnel-shaped gulf is formed by the sinking down of the atmospheric strata, there is a disturbance in the equilibrium of the flocculent masses, precipitation of adjacent layers into the orifice, and accumulation of vaporous matter at this part of the atmosphere, as is shown by the faculæ heaped up in the vicinity of a dark cavity. It seems as if this affluence of a vaporous fluid gave rise to a heaping up (*bourrelet*) of atmospheric masses round a dark spot. At the base of these mountains a fusion takes place, and when the changes are very rapid, lines of dislocation are observed, circumscribing the annular mountains, and rendering them top-heavy, so that they fall and give rise to a penumbra.

M. Chacornac describes a case in which a small spot approached a large one and fell into its penumbra, without lessening it or occasioning any other change than making a new orifice in its perimeter; and he likens the currents of photospheric matter to the cascades of Niagara, in which the form is preserved. After the examination of this fact, he affirms it to be impossible to regard the spots as occurring in a liquid medium, for he says we should ask how such masses of liquid could be volatilized without occasioning an immense conflagration when they were converted into gas? Immense photospheric clouds dissolve in a few hours, though their volume may be greater than that of the earth.

M. Chacornac considers that the hypothesis of solar volcanoes arising in a liquid medium cannot be maintained, as the phenomena can only be explained on the supposition of rapid currents occasioned by the formation of a vacuum. A *central* body in a liquid state would not, he thinks, be in contradiction to the general phenomena exhibited by the sun. It would be the source from which emanates that cloudy mass which constitutes the solar atmosphere of which the limiting layer is in a state of lively incandescence. According to this hypothesis the temperature decreases from the circumference to the centre, as the law of densities augmenting in the same direction demands. Varying degrees of heat and density in different strata, and the effect of the sun's rotation, would give rise to currents such as are seen in the trade winds, in the belts of Jupiter, and in the motions of sun spots, provided that the atmosphere is situated upon a solid body.

M. Chacornac thinks that the sun may consist of a central liquid covered with a solid pellicle, and surrounded by an atmosphere composed of several layers, which in their normal condition appear in contact and united. The pellicle,

or crust, is ruptured by volcanic action, and eruptive currents dissolve the photosphere.

This paper is an exceedingly difficult one to give an account of; but we have endeavoured to present our readers with its prominent ideas.

THE EXHIBITION OF MINIATURES AT THE SOUTH KENSINGTON MUSEUM.

BY W. M. ROSSETTI.

(*Concluded from our last.*)

In resuming our notice of this Exhibition, necessarily very far from exhaustive or complete, we come first to the

BRITISH PORTRAITS OF THE STUART PERIOD AND THE COMMONWEALTH.

Lady Arabella Stuart was, and deserved to be, frequently painted. In No. 486, by I. Oliver, she is not so pretty as in some other portraits, and tends to the Mongolian type of visage.—No. 1580, by the same, was painted at a somewhat later period of life than most of the portraits of this beautiful and ill-treated lady; here she has a melancholy look, instead of the blooming and exuberant air of the earlier likenesses, and one can guess that the iron has entered into her soul.—In No. 2169, by the same, "she is represented with her long auburn hair hanging on her shoulders, wearing a close lace falling collar or ruff, a pearl in one ear, and a black ribbon in the other."—A fourth likeness, by the same, "with a jewelled anchor as an ear-ring," is very charming.

Elizabeth Stuart, Queen of Bohemia, by the same, "is represented young, wearing an open lace ruff, over which her light auburn hair falls upon her shoulders and down to her waist;" a very agreeable portrait.—P. Oliver also has painted a fine miniature, the face not unlike that of the greater Elizabeth, "Good Queen Bess."

Lady Shirley, by Hilliard, "represented with her hair falling loose on her shoulders, and wearing a wreath of oak leaves," was a charming woman, who pretty evidently knew that fact, without losing the grace of being natural.—I. Oliver's version is also very handsome.

Frances Howard, Countess of Essex, ascribed to P. Oliver, an excellent portrait of Sir Thomas Overbury's poisoner, shows us a fine woman, with an open, unembarrassed counte-

nance, not such as one would be inclined to associate with her criminal career. She certainly, however, does not look as if opposition to her will would be very tolerantly received.—I. Oliver gives a face not wholly unlike that of Arabella Stuart, with a coquettish air, and broader.

Of *Charles I.*, one portrait, "formed of the King's hair dipped in his blood on the scaffold, belonged to John Winckley, who was executed at Lancaster Castle in 1716, with the Earl of Derwentwater, for the Jacobite rising of 1715."—Another, by Snelling, 1647, drawn with the brush on paper, is very careful and agreeable.—In Charles when young, by P. Oliver, it is difficult to trace the countenance so unmistakeable in after years.—Another portrait (painter anonymous), oil on copper, is a record of the king's later days, showing forcibly the points of resemblance to his father James I., and not much more noble-looking than that monarch. "It is said that, for some months before his death, the king refused to allow his beard to be cut. On the other side of the frame is a portrait of Bishop Juxon, his faithful servant and attendant upon the scaffold."

Venetia Lady Digby, 1633, by P. Oliver, after Vandyck. "Represented as she was found dead in her bed. She is mentioned by Lord Clarendon as 'of an extraordinary beauty and as extraordinary fame.'"

Old Parr, by Professor Way, of Stockholm (so marked by Mr. Crofton Croker). Copper. We know not in which of his 152 years this portrait of Old Parr may have been painted; he looks old enough to be some way past 100.

Oliver Cromwell, after S. Cooper, enamel, was a present made to Bridget Cromwell on her marriage with Ireton in 1646, and worn by her as a clasp to a bracelet; it is somewhat damaged in surface.—In the portrait by S. Cooper, 1657, the face has a striking expression of honesty, though the miniature is not one of Cooper's very best.—By the same, full-face to the right, is an important specimen, but also not of the painter's best.—Loggan's pencil likeness has a victorious look, yet somewhat "groggy," if so irreverent a term may be applied to any likeness of the hero.—In the "Profile drawing in pen and brown, tinted, by S. Cooper, from which Houbraken engraved his portrait" (paper), the expression is mild, possibly too much so, but it is a valuable likeness.—In No. 1472, by the same, the age is apparently about thirty-five; the face longer and thinner, and the nose more nearly straight than in most portraits.—No. 1873, painter anonymous, is a very small and clever miniature, giving a somewhat exceptional version of the face.—Another, in profile, by S. Cooper, "was sold by the Lady Cornwallis to Sir Joshua Reynolds for 100 guineas. He be-

queathed it to Mr. Richard Burke, who left it to Frances Lady Crewe, from whom it descended to her grand-daughter, the present Lady Houghton."

Richard Cromwell, 1649, by the same, exhibits a long, pale, hatchet-face.—The miniature by Hoskins, jun., 1659, together with one of Ireton, and an enamel of Oliver Cromwell, were the property of Bridget Cromwell (Mrs. Ireton), and afterwards of Elizabeth Ireton (Mrs. Polhill): the three have ever since remained in the possession of her lineal descendants. There is a curious look in Richard's face—or else one fancies it—of being the fool of the family.—S. Cooper, 1647, gives the sitter a thoughtful but ineffectual look.

Elizabeth Claypole, Cromwell's favourite daughter, by the same, 1653, is finely done, but rather deficient in corporal development.—A profile by the same, pencil, is rather a poor version of the face.

Mary, Countess of Falconberg, third daughter of Oliver Cromwell, by the same, a handsome woman, is a fine specimen of the painter.

Bridget Ireton, Cromwell's daughter, 1652, is also by the same.

General Ireton, 1649, by the same, shows a fine face, not wholly unlike that of Gaston de Foix.

General Charles Fleetwood, the second husband of Bridget Cromwell, 1656, is again by the same.

Sir Harry Vane the Younger, oil, has a strong, handsome face, worthy of the man.

Charles II., by Loggan, pencil, is one of the most interesting versions of the grim visage of the "Merry Monarch," showing some true family likeness to both his father and his mother.—S. Cooper's portrait, 1665, with the mantle and collar of the Order of the Garter, is large and rather unfinished, but very able.—Loggan's in black lead, "probably the original drawing from which Loggan engraved the published portrait," is also excellent.—No. 2032, Charles II. when young, painter anonymous, and No. 1014, catalogued simply as "Portrait of a gentleman," are duplicates.

Catharine of Braganza, Queen of Charles II., if her miniature is a true record of the neglected queen, looked of as easy virtue, and displayed her charms with as much liberality, as any of the beauties who competed for her husband's attentions.

James II. as Duke of York, by Petitot, is an enamel, very complete and actual. Here we find a true historic style in the very smallest dimensions.

Jacob Hall, the rope-dancer and comedian in the reign of Charles II., oil, must have been an exceedingly handsome

fellow, with the beauty almost of a woman, and the audacity of a man. One need not wonder at the favour he found among the easy fair ones of the period.

FOREIGN PORTRAITS UP TO THE REIGN OF LOUIS XIV.

Francis I., ascribed to Clouet, oil, gives a handsome version of the face, though, as always, extra French in its peculiarities.—In *Francis and the Duchesse d'Etampes*, by Luca Penni (oil, mounted in a crystal locket), the king is making love to his fair one, with Cupid to preside over the transaction. Very charming.

Charles V., in one of his likenesses, seems hardly more than twenty years of age, with a more aquiline cast of feature than in his later portraits.—Another, about 1520, is ascribed to Holbein.

Philip II. of Spain, by Luis de Vargas, 1555, oil, is a companion to the portrait of our Queen Mary, by the same painter; also very fine.—Another so-called Philip II., painter unnamed (No. 1281), appears to us extremely questionable.

Calvin, by Holbein. Oil. We have some doubt of the authorship of this portrait. Calvin is here presented as a young or youngish man; the nose long, with no aquiline tendency, the eyes blueish grey, the complexion light, the expression reflective.

Catharine de' Medici, inscribed "B—56—1581," oil, has here a sort of motherly look, though not of a noble type. The inscription suggests a fib on her part, or else flattery on the part of the artist, for she was 62 years old, instead of 56, in 1581.

Admiral de Coligni, by I. Oliver, is a perfect small specimen of the best class of miniature-painting.

The Duc d'Anjou, the suitor of Queen Elizabeth, half length, constitutes a largeish miniature. The duke has a somewhat meagre and hungry aspect, but is not so ugly as tradition reports him.—Clouet's version, "holding what is supposed to be a miniature of the Queen in his right hand," oil on copper, is an excellent portrait, giving the duke something of a "fast" look.

FOREIGN PORTRAITS FROM THE REIGN OF LOUIS XIV. ONWARDS.

Louis XIV. as a boy, by Petitot. Enamel.—The same, when young, by Petitot. Enamel. (No. 1185.) These are two out of a huge number of likenesses of the Grand Monarque, by this famous enamel-painter, and other artists. No. 1185 is remarkably perfect in execution, and gives a handsome version of the face.

The Duchesse de la Vallière, by the same. Enamel.—Another, anonymous, very loveable.—A snuff-box, "exquisitely enamelled, with the top, bottom, and sides ornamented with beautiful portrait-miniatures of the celebrated beauties of the Court of Louis XIV. The medallion on the top of the box represents la Duchesse de la Vallière in the centre; la Duchesse de Fontagnes to the right; Madame de Maintenon to the left. The medallion on the bottom represents Hortense de Mancini, Duchesse de Mazarin, in the centre; la Marquise de Montespan to the right; Mdlle. Dupré, "la belle jardinière de Meudon," to the left. The medallion in front, la Duchesse de Brissac in the centre; Mdlle. de Blois, Princesse de Conti, fille de la Duchesse de la Vallière, to the right; la Contesse de Grignan, fille de Madame de Sévigné, to the left. The medallion at the back, la Duchesse de Nevers in the centre, the sister, and la Duchesse de Sforce to the right, the niece of la Marquise de Montespan; Henriette de Coligni, Contesse de la Suze, to the left. The medallion at the right end represents Ninon de l'Enclos in a green dress. The medallion at the left end is a portrait unknown. This beautiful work of art was formerly in the cabinet of the Marquis de la Reignère" (now of Mr. George Bonner).

Madame de Maintenon, by the same, enamel, appears to be about the age of twenty-three. Very lovely and engaging—more so than any other portrait we know of this lady.

The Regent Duke of Orleans. One of the enamels of this famous debauchee, No. 819, is catalogued as "Philippe d'Orleans, Regent of France, and brother of Louis XIV" (!) So absurd a historical blunder ought not to have been let pass. Indeed, we must say, while making every allowance for the difficulties of various kinds which, no doubt, beset the compiler, that the catalogue is not free from some considerable blemishes. The information given under one heading is continually repeated under another; and this information, even when not incorrect, as in the present instance, is too often twaddling or supererogatory. Here are two or three specimens: "Robert Devereux, Earl of Essex, 1567—1621 [should be 1601]. The favourite of Elizabeth, and the hero of the romantic story of a ring entrusted by him to the Countess of Nottingham, the non-delivery of which was supposed to have consigned him to the scaffold." "Armand Jean du Plessis, Cardinal Richelieu, 1585—1642. A celebrated French Minister in the time of Louis XIII., and well known for his persecution of the Huguenots." No. 1016, catalogued merely as "Portrait of a Gentleman," is, in fact, a copy of a well-known female head by Greuze. "Paul Rembrandt van Ryn, an eminent Dutch painter and etcher." "William Cecil, Lord Burleigh, 1520—

1598, Lord High Treasurer and Secretary of State to Queen Elizabeth. He is said to have had a principal share in the administration for upwards of forty years." "Horace Walpole, the well-known literary character of the last century." Nos. 1859—60 are recklessly catalogued as "Earl and Countess of Kildare, 1734. Oil. Ascribed to Hans Holbein;" whereas the costume is about one hundred years later than the date of Holbein's death, 1543. "George Monk, Duke of Albemarle, a distinguished military and naval commander in the Civil Wars during the reign of King Charles II." (!) Titian, who died in 1576, is credited with a portrait, at a mature age, termed Galileo, who was born in 1564, and which presents very little resemblance to that philosopher. "H.R.H. the Princess Marie Amalie, sister of Louis Philippe," should be "Madame Adélaïde," the name given in the catalogue being that of Louis Philippe's *wife*, the venerable ex-Queen of the French, still surviving.

The Empress Catharine II. of Russia, given by herself to W. Fawkener, when on a mission to Russia in 1791, is one of the best portraits of the Empress, apparently about the age of thirty-two: a face as of marble that would yield to the touch. —In Boit's enamel, somewhere about the same age, the Empress is represented with her brown hair unpowdered, and with a somewhat jolly and vulgar look.—She reappears "in the dress (a semi-masculine one) she wore in the Crimea in 1787,"—and again, "a great likeness," towards the age of sixty-five.

The Emperor Paul of Russia presents one of the most grotesque faces ever invented by the arch-caricaturist nature; something between the popular idea of Robespierre and a skull, simpering.

The Chevalier d'Eon. "A notorious character in the last century," says the catalogue, "who for many years passed himself off for a woman." We are not aware whether many people in England know that the most elaborate of the Chevalier's biographers declares him to have been the father of our late beloved sovereign George IV.! Let us add that the evidence adduced to sustain this astounding hypothesis is no evidence at all, and scarcely, even supposing it to be accurate, amounts to a faint suggestion or suspicion. In this portrait the Chevalier appears in his female garb, and, without being handsome, makes a good-looking woman enough.

PORTRAITS ILLUSTRATIVE OF THE FRENCH REVOLUTION AND FIRST EMPIRE.

Marie Antoinette. Among various portraits of this Queen, the most interesting, from its associations, is one by Ströhling

(No. 2189), belonging to a set of five, labelled "Presented (No. 3 excepted) by Queen Marie Antoinette to her foster-brother the Chevalier Weber."

Madame Elizabeth belongs to the same set. Unless this is a flattering likeness, the true-souled sister of Louis XVI., the one of the guillotined royal trio whom one can most unreservedly pity and commend, was an extremely pretty woman.

The *Princesse de Lamballe* was painted at full length, seated, by Sicardi, approaching in size the miniatures of our Thorburn.—We have always been taught to speak of "the lovely Princesse de Lamballe." That lady can have looked with little favour upon the painter of another of her portraits (anonymous) who has made her almost "a guy."—Hall gives a very different version of the face, partaking of the chubby and cherubic.

The miniature of *Robespierre* is a very interesting record of the best-abused man of the last hundred years, but whom some few people have by this time found out to rank among the heroes, and some, still fewer, among the benefactors, of the world's history. It is a well-painted portrait, and looks as if its evidence might be trusted as far as it goes. The face is an unmistakeably clever one, with something of the smile and aspect of Voltaire, and a great air of self-confidence, trenching upon self-applause. There is a direct look in the eyes, not at all suggesting an abject or malignant nature; both they and the eyebrows are dark, the hair powdered, the costume neither dandified nor slovenly. This portrait does not in any degree confirm Carlyle's famous term for Robespierre, "seagreen incorruptible;" on the contrary, the complexion is full-coloured, tending towards sanguine.

Murat furnishes a head-and-shoulders portrait, done on a largeish scale for a miniature. He looks an "ugly customer" for anybody to argue with or make an impression upon.

Camille des Moulins, by Augustin. A face which testifies to its owner's brilliant talent.

Napoleon I., by Isabey, is one of the best-known likenesses of the Imperial time.—The same, painter anonymous, "given by Marshal Soult to Sir William Napier," is a rather poor, "soppy" version of this magnificent head, about the age of forty-five.—Of a crayon study by Longhi, "an autograph letter of the artist says that this portrait was taken while Napoleon, then First Consul, was hearing a prolix address in the Cathedral of Milan." It is a profile, pretty fair.—Napoleon, "when young," by Isabey, is but a poor treatment, and the age does not seem to be particularly "young," but about forty. The miniature was presented by Napoleon's venerable mother to

his physician at St. Helena, O'Meara.—The same, ascribed to Isabey, rather an overdone version, and not of the best, was presented by Napoleon "to one of his Marshals before the Russian campaign in 1812. The seal is the original one of the letter of presentation to the Marshal."—The same, signed "M, 1815," "mounted in a round, gold-lined snuff-box, was given by the Emperor to one of his Marshals during the Hundred Days."

The Empress Josephine, by Vandenberg, 1800, is a very unflattering portrait. Josephine was thirty-seven years of age in 1800, and passed for being younger: here she looks more like fifty.

Lady Hamilton, with her hair and initials at the back, painted probably during her residence in Naples. This miniature was worn by Nelson at the battle of Trafalgar, and was taken from his neck after his death.

Wellington, by Isabey, 1816.

General Acton, the Minister of Naples. There is nothing very noticeable in the face of this celebrated intriguer: one would have expected something more decisive, to mark the man.

Madame Récamier, by Isabey. This celebrated beauty and queen of the Parisian salons seems, by the present portrait, to have had too large a head, and singularly small arms. The air of grace is nevertheless preserved.

BRITISH PORTRAITS FROM THE REIGN OF QUEEN ANNE, ONWARDS.

Lady Arabella Fermor, the heroine of Pope's "Rape of the Lock." Oil. "She gave this portrait to one of the Wakemans, and at the same time refused his proposal."

The Coalition, *Lord North and Charles Fox*, enamel, is an amusing grotesque: a coalition-face, one half being proper to the North and the other to the Fox visage.

Mr. O'Hara, by Pompeo Battoni, is very perfect for style and the look of life. It is seldom, so far as we know, that this distinguished painter, originally a goldsmith, appears as a miniaturist.

George IV., as Prince of Wales, by Cosway. The remarkable good looks of the prince in his youth, approaching to handsomeness, but not entirely transcending prettiness, are fully brought out in this likeness, among others.

In the *Mrs. Fitzherbert*, by Cosway, this lady, so much talked of on account of her private marriage to the Prince, afterwards George IV., is represented as somewhat *passée*, and with a cast of countenance not unlike Mrs. Siddons.—The Exhibition contains also the Wedding-Ring of the Prince and

Mrs. Fitzherbert—"a gimmal ring, with the name George Augustus Frederick engraved within the hoop;" the eye of Mrs. Fitzherbert, represented in miniature upon a vapoury ground; and a similar painting of the eye of the Prince of Wales, set in a ring.—Another portrait of Mrs. Fitzherbert, by Cosway, 1788, is younger than the one first-named, and much prettier, though the features are rather large.

Mrs. Siddons, by Edridge.—By T. Harding. About the age of sixty, with an air of tragedy in private life.—By Cosway, before 1784. Of almost Jewish aspect.—Mrs. Siddons in the character of Zara, drawn by Lawrence when only twelve years old. Crayons.

Mrs. Robinson, "Perdita," in the manner of Shelley, but ascribed to Cosway, looks very much as if she were determined to set her cap at any and every eligible man, and perhaps she was so. This (No. 739) is a duplicate of No. 2592, catalogued as "Portrait of a lady unknown, by Michael Keene."

Mrs. Bayly, 1773, is a charming portrait, somewhere between the styles of the elder miniaturists, of Cosway, and of his successor Ross. The experts ought to identify the author, and give him the credit of his work.

Lady Carteret and Lady Caroline Moreland, by Cosway, present a good example of Cosway's style; partaking at once of the pale clearness and simplicity of the older miniatures, and of the vivacious, *dégagé* air which is more especially modern.

Two Ladies, by the same (Nos. 1420—21), also furnish a characteristic example of the painter. He is often charming, and always in good taste, and in colour inclines mostly to modest and greyish tints. A tendency to flattery, however, is unmistakeable, along with some extra coquetry of hair, drapery, etc.

AUTHORS, PHILOSOPHERS, ETC.

Erasmus, ascribed to I. Oliver, if really by Oliver, must, according to chronology, be a copy. It is a youthful likeness, some twenty-four years of age.

Spenser, by Hilliard, is a small picture, which seems to have been retouched. The face has a sufficiently individual look, but is wanting in prominence.

In *Bacon*, by P. Oliver, inscribed "Anno Dni. 1620, Ætatis suæ 60," the hair is still abundant and perfectly brown.—No. 2662, ascribed to the same painter, appears certainly to be not good enough.

Lady Mary Wortley Montague, in the costume worn by her in Turkey, is a three-quarters figure excellently painted: a slight greyish or greenish tint in the flesh-shadows suggests that it may be by a French artist.

Percy Bysshe Shelley, by Easton, "from the original in oil by Miss Curran, painted in Rome, 1819, now at Boxcombe," is the well-known version—almost the only one extant, we believe—of the divine face of this most divine poet and man. Shelley was twenty-six years of age in 1819, whereas this looks more like eighteen; but his extreme juvenility of aspect is attested from many quarters.

Alfred Tennyson, about twenty, by Miss Dixon, is the portrait engraved in Horne's "New Spirit of the Age." It can scarcely be supposed to do justice to the early youth of so noble a face as Tennyson's, but it is none the less of considerable interest.

PAINTERS.

Michael Angelo and Giulio Romano, by Sebastian del Piombo, oil, is a very fine work. Michael Angelo is represented at the age of about fifty; his countenance very Italian in type and somewhat haggard, his hair black, just beginning to grizzle. Giulio Romano, who was thirty-two when Michael Angelo was fifty, here looks nearer forty, and the head does not strike us as much like other known portraits of the painter.

Jacopo Tintoretto, by himself. Oil, on copper. This capital portrait represents the great painter evidently at a very early age, hardly perhaps past fifteen. If really a portrait of Tintoretto, it is singularly interesting; we should like to know whether there is any clear authentication of it forthcoming.

Holbein, by himself, oil, is an interesting portrait, at about the age of thirty-two, with a direct discerning look.

Nicholas Hilliard's portrait has been copied by G. P. Harding, from the original by Hilliard, in the collection of Lord de l'Isle and Dudley. The admirable miniature-painter appears from this record to have had the handsome and courtly aspect so well appreciated by his sovereign mistress Queen Elizabeth; there is a true touch of the artist as well.

Velasquez, by himself, oil on copper, presents a splendid record of the thin long face of this great master.

Rembrandt, by himself, oil, is a clever portrait of very early youth, hardly perhaps exceeding the age of sixteen.

Samuel Palmer, 1829, by George Richmond. The admirers of the poetical landscapes of this water-colour painter will be pleased to see so handsome and troubadour-like a head of him in his youthful prime.

"*Portraits*" (No. 3080)—*the Artist and his Wife*, by Wells, shows, with great typical completeness, the highest development of subject, scale, and execution to which miniature art had attained in the final years of its prosperity: many

visitors will remember the picture's appearance in the Academy exhibition of some seven or eight years ago. It is a regular portrait-picture subject, with three figures—the painter, his wife seated on a donkey, and the Italian donkey-boy—and a landscape background. We have already assigned some reasons for thinking that the simple conception of miniature art in its earlier years was the truer one; but this picture by Mr. Wells may fairly be cited by opponents as an argument to the contrary. It makes us hope, at any rate, that the condition of the art will, within Mr. Wells's lifetime, again become such as to permit of his devoting to it a considerable share of his time and abilities. The miniature here before us is in every way interesting; as, besides being a leading specimen of the art in its latest range, it contains true and valuable portraiture, not only of the artist himself, but of his wife, a painter of quite singular genius among women, snatched away, by early death, from a career which could not but have been distinguished, and eminently encouraging to her sister-practitioners in the art.

MISCELLANEOUS PORTRAITS, CONTEMPORARY OR QUASI CONTEMPORARY.

The Princess Royal, as a child, 1845, by Ross; offers an elegant example of this excellent miniaturist.

Lady Banks, by the same, is also a fine specimen of the painter, who has here had as subject the extreme of healthy, almost rustic, comeliness in a lady.

The Countess of Shaftesbury (then Lady Ashley), about 1834, by the same, is a very good specimen, pure and unlaboured, with a tinge, in point of expression, of the then still partly dominant style of Lawrence.

Two Children of Mrs. Pollen, by the same, is the well-known and admired miniature in which a girl clasps her little brother round the neck. While delicate in flesh-painting, there is rather too decided a touch of Lawrence in the feeling of the group.

The Artist's Children, by Linnell, sen., 1824. The present generation of exhibition-visitors has almost forgotten that Linnell, one of their most cherished artists as a landscapist, was originally a portrait-painter. This miniature, in which the children are revelling in the society of a kitten, is remarkable for its rounded relief, the extreme reverse of the old school of miniature art. It has conspicuous merit notwithstanding.

The Countess of Chesterfield and Lady Evelyn Stanhope, by Thorburn. We all remember the impression which Thorburn's large miniatures, highly wrought in execution and in their feeling for beauty and elegance, used to produce year after

year at the Royal Academy up to some ten years ago. This is one of the most adequate examples of his elaborate style included in the present exhibition; we should have expected to find a fuller representation of so admired a miniaturist.

"*Alice,*" by Wells, is an excellent miniature, showing the best attainment of the modern school; not unlike the works of Ross, but with greater force.

With this example we bid adieu to the exhibition; only regretting that we have been compelled to mention much fewer works, and those much more summarily, than the number, importance, and interest of the specimens displayed would demand. Our limits of space have compelled us to omit several names of sitters no less distinguished than Queen Henrietta Maria, Strafford, Hampden, Algernon Sidney, Henri IV., Sully, Condé, Turenne, Charles XII., Peter the Great, Maria Theresa, Frederick the Great, Lafayette, Talleyrand, Nelson, Marlborough, the elder Pitt, Clive, Warren Hastings, Washington, Montaigne, Lope de Vega, Ben Jonson, Milton, Corneille, Molière, Dryden, Newton, Pope, Swift, Voltaire, Kant, Scott, Byron, Raphael, Rubens, Wren, Handel, Reynolds, Flaxman, Wilkie, and Napoleon III.

REMARKS ON THE STRUCTURE AND ACTIONS OF THE IRIS OF THE EYE IN SOME SPECIES OF FISHES.

BY JONATHAN COUCH, F.L.S., ETC.

THE eyes of fishes differ in a remarkable degree from those of quadrupeds, birds, and reptiles, and especially in the want of a power by which the amount of light to be admitted may be regulated; and in consequence of what has been noticed of this, that portion of the eye of this class of animals which is termed the Iris has from the earliest times been considered as merely an immovable curtain or diaphragm, altogether incapable of contraction or dilation. In the second volume of *Loudon's Magazine of Natural History*, new series, Mr. Dalrymple remarks that he was never able to discover the slightest movement in this portion of the eye, and after many attentive observations on the cod family, the gurnards, and several others, I have arrived at the same conclusion. As regards the smooth blenny, or shanny, in particular, they have been subjected to the inquiry when at liberty in their native pools, where they were enticed by baits placed at different distances, to which they are never indifferent; but while looking at these

tempting objects, even at the distance of fourteen feet or nearer, no motion of the iris was perceptible; nor was there any change when the fish has been removed from the water into bright sunshine. The living young of the picked dogfish have also been taken from the body of the parent and exposed to the glare of a bright sunshine without any sensible effect on the iris; and when several examples of different kinds of fishes were examined, in order to ascertain whether some difference in the extent of this organ might be discerned in one or other of the several species, the result was that nothing further could be detected than might be looked for in the difference of size or other particulars of the same sort. But the result of our inquiry was somewhat different when the inquiry was extended to the species of the sharks and rays. But first, in the flat fishes, or *Pleuronectidæ*, the line of vision is not directed upward, as is often represented in the stuffed examples of museums and in many engravings; but the eyes are raised above the surface, and directed laterally, so that vision is protected from the glare of too much light, and the upper portion of the iris is so far bent downward as sometimes to serve the purpose of a partial screen; but still without the power of motion or contraction; while in the depressed section of cartilaginous fishes, or the rays and skates, this upper portion of the iris not only receives a new shape, but it is endued with a new property, which has an influence on the further modification of the eye itself, or the particular function of sight. The curtain, or veil, which hangs down from the upper portion of the iris is, in fact, a covering to the superior border of the pupil, for which it serves a use that has been particularly pointed out in our *History of the Fishes of the British Islands;* but it is to a peculiar structure of this portion of the eye in these fishes that I wish to direct particular attention. On attentive examination of this portion of the iris of these fishes, it is seen that on the anterior portion the surface is smooth, and not, as in birds, striated and irregular; but in its substance the texture is loose, and viewed under a microscope it appears to be composed of an exceedingly fine, but irregular network, which is not composed solely of vessels, but is more loose about the middle distance between the pupil, or inner border of the iris, and its outer circumference; and it becomes more condensed as it approaches the pupil in one direction and the circumference on the other. At what may be termed the border of the pupil there is a condensed rim of the same texture, so that the iris itself has a finely granular appearance, and the condensation is directed along even the border of the fringes of the dependent curtain; which portion of the iris, if we may judge from the difference of appearance it

presents at different times, possesses a power of dilation, or extension and contraction. In some examples of the fishes on which these observations were made, the curtain was only let down sufficiently to hide half the space of the pupil, while in others little of it could be seen until it was brought down into sight by the aid of the point of a needle, and again in others it extended so far as to shut up the whole of the pupil, except what could be discerned between the intervals of the fringe.

And not only do these curtains present a different appearance in different individuals, but even in the same fish this extension of the curtain shall be widely different in each eye, so that in one it shall almost entirely cover the sight, and in the other it may be scarcely capable of being discovered; a circumstance which goes far to show that the eyes of at least many fishes have a power of vision independent of each other, in a manner or to an extent wholly unlike what we perceive in ourselves, or in any animal of the land. The muscle discovered by Mr. Dalrymple, which influences the position of the crystalline lens of the eye, is present in that organ in the *Pleuronectidæ*, and also in the rays; but the curtain we have described appears to be the more required in the last-named fishes, from the circumstance that their range of action is often from a considerable depth of water, at the bottom to the broad daylight of the surface.

In the toper, the pupil is simple, without those appendages which we observe in the rays, and in its form transversely ovoid, furrowed on the surface, and in some examples much larger than in others. A remarkable circumstance connected with the eye of this fish is, that if, when newly taken from its native element, it be laid on its side in such a manner as to keep one of its eyes altogether out of the influence of light, the pupil of the darkened eye will become dilated, while, if the light be strong, the other will become contracted into an irregular line, and folds will be discerned in it, radiating more especially to the inferior border, and yet, on its anterior surface, there could not be seen any appearance of fibres, nor any special organization beyond the folds produced by the contraction, which were of a radiating and not a circular character, and those were for the most part near the margin of the pupil. Something similar to this occurs also in the picked dog, but there is so far a difference that the pupil in this species is perpendicularly ovoid instead of being transverse, and there is no regularity of action in its contraction and dilation as regards the comparison of one with the other, but each of them claims an entire independency, so that uniformity between them is altogether a matter of accident.

But however difficult it might be found to discover the muscular fibres of the eyes of these fishes while they were

alive, their action proved that they certainly existed, and further research in the dead subject became, therefore, necessary. With much care the iris of the eye of a toper was removed from its adhesion to the choroid, and placed smoothly on a piece of glass; when the radiating fibres could be as readily distinguished as usually in the human eye. It was then placed in water, where it was allowed to macerate for a few hours, and then the aqueous membrane was easily peeled off, and the pigmentum nigrum removed by agitating the fluid. Thus cleansed from their covering these radiating fibres were rendered far more distinct, and there was perceived also the very faint resemblance of a cœrulean band at the margin of the pupil. When the preparation thus formed had become dry the radiating fibres became much more distinct, and at this time also the circular band was rendered as clearly marked as the radiating fibres themselves, although no fibres could be discerned within it.

It is proper to add, as a melancholy tribute to his memory, that a large portion of these observations were made by my late son Richard Quiller Couch, of Penzance, at the time when he had not yet left his home at Polperro.

NOTES ON FUNGI.—No. IV.

BY THE REV. M. J. BERKELEY, M.A., F.L.S.

ROSE-SPORED MUSHROOMS.

(*With a Coloured Plate.*)

I HAVE already pointed out that a single species with decidedly rose-coloured spores, *Agaricus euosmos*, occurs in the white-spored series, but its affinities with the common Oyster Mushroom, *A. ostreatus*, are so intimate, that it would be in direct opposition to nature to separate them. The series respecting which I am now about to make some observations is extremely natural, and the species are not likely to be confounded with any in the remaining divisions. One species alone, *A. cretaceus*, a near ally of the common mushroom, might be sought for amongst the rose-spored Agarics (*Hyporhodii*), as its spores are very pale; indeed, so pale that there is occasional danger of its being referred on a superficial glance to *Lepiota*, especially as its gills are at length remote, as in several species of that subgenus. The spores of *Hyporhodii* assume two distinct forms: in one they are perfectly

even and regular, though wider on the outer side of the major axis than the inner; in the other they are altogether irregular, with three or four obtuse angles, and a large distinct nucleus.

The subgenera of *Hyporhodii* are the following—*Volvaria*, *Pluteus*, *Entoloma*, *Clitopilus*, *Leptonia*, *Nolanea*, *Eccilia*. The two first of these have the gills absolutely free; in the remaining divisions they are variously attached, though sometimes very slightly, and often separating from the stem at maturity.

The first subgenus, *Volvaria*, which derives its name from the volva being developed as strongly as in the most noble *Amanitæ*, and whose species in many respects approach *Agaricus cæsareus*, figured in the number of the Intellectual Observer for April, 1865, No. 39, contains a few very fine species. The hymenophorum is perfectly distinct from the stem, and though the universal volva is so highly developed, there is no partial ring, a peculiarity which is observable in the whole of the series. The gills are regularly rounded behind, and sometimes they almost adhere together like the gills of *Coprini*, in consequence of the high development of the cysts which are scattered over them. They are moreover inclined to be deliquescent, and agree with the fugitive *Coprini* in their affecting richly-manured spots, very decayed wood, or fermenting vegetable matter, as tan. They are not in general reckoned esculents, though *Agarius parvulus*, which abounds in rich grassy pastures, often gets into the mushroom basket, either wilfully or accidentally. Viviani seems to think that all the species of this subgenus are esculent, but he very wisely adds a caution that we must wait for experience till we make any positive assertion in the matter.

Agaricus volvaceus sometimes grows in great abundance on spent tan in hothouses, and one or two closely allied species, but with a viscid pileus, occur now and then on the sides of pathways. *Agaricus coffeæ*, Viviani, has been found only on coffee-grounds left to ferment for some months in a stove in the botanic garden at Genoa. Another mushroom, *A. Neapolitanus*, which is of a beautiful snowy white, and not like the last reddish and streaked with darker lines, and apparently of very different affinity, as the gills are very decurrent and there is no mention of a volva, is procured in some quantity at Naples in a similar way, and is constantly eaten. The coffee-grounds are put into an earthern unvarnished vessel, which is placed in the shade and slightly watered occasionally, and the fungi appear at the end of six months. I tried more than thirty years ago to obtain it in the same way in England, but was not successful, perhaps from not having a sufficient quantity of coffee marc at my disposal.

FUNGI.

1.—Agaricus incanus, Fr. var.
2.—Agaricus flammans, Fr.
3.—Agaricus albo-cyaneus, Desm.
4.—Agaricus appendiculatus, Bull.
5.—Agaricus bullaceus, Bull.
6.—Russula emetica, Fr.
7.—Mitrula paludosa, Fr.

A very curious species, *A. bombycinus*, occurs now and then on very rotten wood of elm, lime, etc., and is remarkable for its silky pileus and very dark-lobed, sometimes almost viscid, volva. I must mention another species, *A. Loveianus*, because of its singular habit. It grows parasitically on decaying *A. nebularis*, and, with its snow-white silky pileus, ample volva, and rose-coloured gills, is extremely beautiful. It was first noticed in the journal of a naturalist by Mr. Knapp, under the name of *A. surrectus*. Figures of this, *A. bombycinus* and the viscid *A. speciosus*, will be found in the *Outlines of British Fungology*.

It is time, however, to go on to the next subgenus, *Pluteus*, which derives its name from a Latin word signifying the sloping covering which protects parties working a battering ram. It differs only from *Volvaria* in the total absence of a volva, the pileus, gills, and stem being quite of the same nature. The species grow on decayed trunks of trees, sawdust, or on ground consisting very largely of decomposed wood. None of the species are considered esculent. The gills are sometimes yellow at first, but soon become pink from the spores. Many of them are very pretty, and *A. leoninus*, figured in the *Outlines*, when brightly coloured, with its deep scarlet pileus and pure yellow stem, is one of the very handsomest Agarics I ever met with. The pileus in this subgenus is sometimes silky, sometimes smooth, and in *A. phlebophorus* the cuticle is singularly wrinkled. *A. petasatus*, which occurs sometimes abundantly on large heaps of sawdust near sawmills or in cellars, is a most magnificent species.

Entoloma (from ἐντὸς, within; and λωμα, a veil), the veil being potential rather than definite, comprises several species belonging to three distinct groups, distinguished by their gills, which are often nearly free or slightly adnexed, being sinuated behind, while the margin of the pileus is at first inflexed. The stem is of a fibrous, fleshy consistence, or occasionally waxy. The more typical species often attain a large size. None, however, are admitted as articles of food, though it is possible that some which have a mealy scent may be wholesome, while in others a nitrous odour indicates unwholesome or suspicious properties. One of the early species, it is not exactly known which, has nearly proved fatal, and experiments therefore should be made with some caution. The three sections are distinguished as follows:—1. Those with a fleshy pileus, smooth when full grown, often viscid but not hygrophanous, and never innato-floccose, or squamulose. 2. Those with a dry, flocculose, or slightly scaly pileus. 3. Species with a thin, hygrophanous, smooth pileus, which has however a silky lustre. All the species grow on the

ground, and while some occur in shady woods, others are found in the most exposed pastures. A figure of *A. clypeatus*, which belongs to the third section, will be found in the *Outlines*. In this, as in all the remaining subgenera of the series, the stem is confluent with the hymenophorum.

The next subgenus, *Clitopilus* (from κλίνω, I incline; and πῖλος, the pileus), is distinguished from the last by its decurrent gills, which are never sinuated behind. It contains a few species only, but one or two of these are of excellent quality, and much admired by fungophagists. We have but three species, of which *A. mundulus* is rare; *A. prunulus*, on the contrary, very common in woods or on their borders, and is excellent either stewed or pickled. The figure in the *Outlines* is not so characteristic as might be wished, but there can be no difficulty in distinguishing the species which, besides its decurrent rose-coloured gills, is known by its dull pruinose white or slightly cinereous pileus, and decidedly mealy scent.

The remaining subgenera contain only small species, which are often remarkable for beauty of colouring and elegance of form, but are too insignificant in other respects, if any of them are wholesome, to be of any economical importance.

Leptonia (from λεπτὸς, slender) bears the same relation to *Clitopilus*, that *Collybia* does to *Clitocybi*. The rigid cartilaginous stem, which is often tinged with blue, is the distinguishing mark, while the gills are never truly decurrent, though they may have a decurrent tooth. The margin is incurved, and the cuticle always broken up into scales. The flesh is always thin, and the pileus often umbilicate. They grow in rainy seasons on exposed pastures, of which, together with the bright-coloured *Hygrophori*, they are a distinguishing ornament in autumn. The sections are characterized by the primitive colour of the gills, without paying attention to which it is impossible to determine the species accurately. They may at first be either dirty white, blue, yellowish or green, grey or glaucous. They often separate from the stem when fully developed. *A. serrulatus*, which is one of the most singular, is distinguished by the black, finely-notched edge of the gills. The green-stemmed variety of *A. incanus*, figured in our second coloured plate of fungi (Fig. 1), which is sometimes very abundant, and is somewhat analogous in point of colouring to *Hygrophorus psittacinus*, is remarkable for its strong odour, resembling exactly that of mice.

Nolanea (from *nola*, a bell), like *Leptonia*, has a cartilaginous stem, but the margin of the campanulate pileus is straight and not incurved. The pileus, moreover, is not umbilicate, and the gills are not decurrent. *A. pascuus* is the most com-

mon species (more common perhaps in Scotland than in England), and may be known from some other allied forms by its gills being much attenuated behind. It is, however, extremely variable. But few species have been distinguished in this country. One of the most remarkable is *A. Babingtonii*, which has the grey shining pileus adorned with dark-brown little tufts of fibres which are free at one end, and a somewhat strigose stem. *A. rubidus*, a very small species figured in the first volume of the *Magazine of Zoology and Botany*, occurs occasionally on soil in hothouses, but whether really indigenous or not I am unable to say.

There remains only the small subgenus, *Eccilia* (from ἔκκοιλος, hollow inwardly), which is distinguished by the truly decurrent gills and umbilicate pileus. Like *Leptonia*, it has the margin of the pileus incurved. A very beautiful species lately figured in the *Annals of Natural History*, occurred at Aboyne, the subgenus being previously unrepresented in this country.

DESCRIPTION OF PLATE.

Besides *Agaricus incanus*, Fr., which has already been adverted to in the present paper, the following species, to which reference will be made in future notices, are figured in the coloured plate.

2. *Agaricus* (*Pholiota*) *flammans*, Fr., a very beautiful species, especially in a young state, which occurs in pine woods in Scotland, attached to fallen branches, and is distinguished by its bright yellow pileus, clothed with superficial hairy scales; its rough stem and yellow entire gills.

3. *Agaricus* (*Psalliota*) *albo-cyaneus*, Desm., a species which occurs in grassy pastures, and is very nearly related to the common *A. æruginosus*, but is far more delicate, and free from scales, as is also the stem; the gills, moreover, are not so decidedly adnate.

4. *Agaricus* (*Hypholoma*) *appendiculatus*, Bull. This is a very widely diffused Agaric, assuming various forms, but always known in its subgenus by the white veil being attached in fragments to the margin, while the gills are at first whitish and then rosy-brown. It occurs either on old stumps, or on soil where chips have been rotting.

5. *Agaricus* (*Psilocybe*) *bullaceus*, Bull. This Agaric grows principally on horse-dung, and when not washed by rain is pretty in form and colour. The pileus is hemispherical, very smooth, but finely striate in the direction of the gills; the stem is short, and more or less fibrillose, and the gills are of a ferruginous brown, very broad, and triangular.

6. *Russula emetica*, Fr., remarkable for its splendid polished

scarlet pileus, with a separable cuticle, and white equal free gills. As the name implies, it is a very dangerous fungus.

7. *Mitrula paludosa*, Fr. One of our most beautiful fungi, always occurring in very moist places, and generally on decaying leaves. Though clavate, it is totally different in structure from the true *Clavariæ*.

ON THE CHANGE OF PLUMAGE IN THE COMMON CROSSBILL (Loxia Curvirostra), WITH A FEW REMARKS ON THEIR BREEDING AND OTHER HABITS.

BY "AN OLD BUSHMAN."

The subject of the change of plumage in birds, whether by a regular or a partial moult, is one of the greatest interest to the naturalist, and in the class of birds of which we are now treating, and which undergo so marked a change, from the dull green nest plumage to the bright scarlet livery of the adult male, there has always existed a doubt in the minds of naturalists as to the age of the bird in which this bright red plumage is obtained. Most naturalists, I believe, leant to the opinion that this dress was assumed in both the crossbills and the pine grosbeak on the *first* moult. I always had my doubts as to this, and an attentive study of both birds in a state of nature, and a careful examination of some hundred specimens of each, in every intermediate stage of plumage between the nest dress and the old bright yellow green of the very old bird, has proved satisfactorily to me that the bright crimson dress in neither is assumed at the first autumnal moult, and probably not till the third, and that in the crossbills especially the male bird undergoes several changes before this red livery is complete.

No one has perhaps had better opportunities of studying the habits of the crossbills than myself. I have now resided for many years in the forests of Sweden—the hot-bed of these birds—and I have paid much attention to the study. I have found it, however, extremely difficult to obtain *certain* proofs of what I state below, although my conclusions are drawn from actual observation of hundreds of specimens, in every stage of plumage—many of them shot from the nest (the most valuable of all to a naturalist who is wishing to solve a difficult problem like the present).

It is only at certain intervals of perhaps two or three years that we have the crossbills breeding in our forests. It is only

when there is a good show of cones on the pine and fir trees that they come to us in any quantities, and when there is no fruit upon these trees we have no crossbills breeding with us. It is also strange that we never on the same year have both the parrot and common crossbill breeding together. In the spring of 1862 we did not take a nest of either bird in our district. In the spring of 1863 I took about thirty nests of the common bird, but only one of the parrot crossbill. In the spring of 1864, I did not obtain a nest of either, and this autumn (October, 1864), I observed the parrot crossbills coming down in small flocks (but I saw no common crossbills), and as they invariably stay over the winter, and breed with us when they come in the autumn, I expect to obtain the nests of the parrot crossbill next March, or even February, but not those of the common bird. Another curious fact is this, that whenever I see large flocks of crossbills in our forests late in autumn, so certain am I that we shall have an open winter, without much snow.

I obtained most of my specimens, and made my observations, chiefly in the very early spring of 1863, when the birds literally swarmed in our forests; and as such an opportunity might not occur again for years, I gave orders to my collectors to begin shooting them in November, when I was certain that the autumnal moult would be complete, and up to the end of January, when they began breeding, I had about a dozen specimens regularly brought in to me every week. From first to last above 150 specimens of male birds passed through my hands, and from the examination of these I draw my conclusions. As I was much interested in the subject, I consulted all the authorities I had at hand to see if I could find any good description of the change of plumage in these birds. Willoughby, Albin, Temminck, Linnæus, Pennant, Montague, Jennyns, Shaw, Thompson, Wood, Morris, Wilson, Nilsson, and Kjärbölling, all lie open upon my table, and hardly two of them seem to agree, or even to afford us any certain clue as to when this change of plumage, which most of them notice, takes place, or how long the red livery is worn, or at what age it is assumed.

A subject, therefore, on which scarcely two naturalists seem agreed, must be an interesting one to investigate.

Willoughby, who wrote in 1668, is quaint, and his style, as is usual with the older authors, "eats short." He has evidently got hold of a female bird, which he describes, and adds: "This bird was described in autumn. He that sold it to us told us that it changed colours thrice in the year, being green in autumn, yellow in winter, and red in spring." He dwells with much unction on the many spiral convolutions in the intestines, and winds up his description with the following quo-

tation from old Aldrovandus: "One thing also more," sayeth Aldrovandus, "seemeth to me strange and unusual in the crossbill—that in the winter time, when all things shrink with cold, and all other things are mute, she sings, which, whether it be true or no, let those observe among whom such birds are common. It sings, they say, very sweetly." Right, old gentleman! The winter song of the crossbill consists of many very pleasing notes, and is heard most when the birds are breeding in the end of the winter.

Albin, who wrote in 1738, follows suit. His description is evidently taken from Willoughby, and his coloured figure represents a formidable-looking dark brown bird, shaded with blue—such as I never saw. There is, however, no doubt about its being a crossbill, when we look at its monstrous beak.

Linnæus does not help us much. "Body varying in colour, reddish, head scarlet," is all that he says.

Old Pennant observes: "It is an undoubted fact that these birds change their colours, or rather the shades of their colours; that is, the males, which are red, vary at certain seasons to deep red to orange, or a shade of yellow." (Thus inferring that the change of colour is *seasonal*, which I can clearly prove is not the case.) "The females, which be green, alter to different shades of the same colour."

Wilson, the American ornithologist, appears also to favour a *seasonal* change of plumage. This idea I do not for one moment entertain. The colours may be a little brighter in the winter than the summer, but that is all.

Montague's description is short and general. He says the plumage of the male varies from beautiful red to orange colour on the head, neck, breast, back, and rump—according to my ideas, just putting the cart before the horse.

Temminck's general description of the adult male is: "Principal colour green. The male, after the first moult until the age of a year, is brick-dust red. Young of the year, grey brown, tinged with green, with dusky longitudinal streaks. Females, at all ages, differ very little from the young." And he further adds that "the female never assumes the red colour which is peculiar to *the male only after the first moult up to the age of a year.*" Here, in my opinion, he is decidedly wrong.

Shaw also says the male varies from a beautiful red to orange colour, on the head, neck, breast, and rump.

Jennyns gives the adult male as cinereous, tinged deeply with green yellow. Male, *after the first moult*, general colour, brick red; female, and young of the year, the same in plumage.

He as well as Morris describes the nest as lined with feathers, but of all the nests which I have taken I never saw a single feather in more than two, and those were stiff pinion

feathers of apparently a bird of the same species, interlaced with the walling of the nest. In fact, the crossbill is no tender bird, and the nest is built of the strongest and coarsest materials, to defy the inclement weather which prevails at the season in which this strange bird has chosen for nidification. It is strange that Nilsson, the great Swedish authority, when speaking of the breeding habits of the crossbill, should say that they breed at all seasons from December to July, and that the winter nest is domed, the summer nest open. This may seem all very natural, but it is not correct. I never saw a domed nest out of the many scores I have taken, although I often wondered that they should not build a domed nest like the wren and the magpie; for often when the month of March has been more than usually cold and snowy, have I found the young ones lying dead in the nest half-filled with snow. The breeding season depends in a certain degree upon the weather, but they never go to nest later than early in March, and by the end of April we shoot strong flyers in our forests. I have taken the nest as early as the end of February, and I never took one with fresh eggs after the very beginning of April. They certainly do not breed twice in the year, at least not in the same district; for about May they begin to flock and leave the forest in which they breed, and during the summer we rarely see them. The parrot crossbill goes to nest usually a fortnight later than the common bird. The nest and eggs of both are much alike, thickly and clumsily built of sticks and moss, that of the parrot crossbill being the largest, and the eggs thicker, and in general more highly coloured. The nest and eggs of the crossbill much resemble those of the greenfinch, but larger. Neither species breed in the deep forest, and seldom in a fir. On stony rises, where the small pines stand wide apart, is the place to look for the nest of the crossbill, at least in Sweden. It is a very easy nest to find, for early in the morning the old male sits on a fir top in the vicinity of the nest, and cheers his sitting mate with a loud and by no means unmelodious song. The nest is always placed close into the stem of the tree, and never high from the ground. The full number of eggs is three; I have seen four, but very rarely.

But to return to the plumage.

Unfortunately, I have not Yarrell at hand. Wood, however, in his *Illustrated Natural History*, by Routledge, which, without being a scientific work, is a very pleasing and useful guide to the naturalist, gives some extracts from Yarrell's *British Birds*, in which both the orange and red plumage is well described. "But," as he says, "a red bird is now before me that had completed his moult before the first autumn."

We may infer that, like the rest, Yarrell considered the red to be the plumage assumed on the first year after leaving the nest. Wood's description of the nesting is correct; but in a similar work by Cassell, we find the following strange account: "Makes its nest of moss and lichen, and fastens it to the branches with the resin of the pine, and covers it with this matter." This I never saw.

Morris gives a good general description, and notices that the young males after the first moult "are variously dull red, reddish, yellowish red, greenish yellow, or dull yellow, shaded with red." Save that I have never yet been able to identify a dull red male just after the first moult, I like this description as well as any. He figures a red male (far too dull, however); but he does not tell us when it is supposed that this red dress is assumed, or how long it lasts.

Although living in the land of crossbills, Nilsson does not help us much. He describes the young bird just after leaving the nest, and also during moults. He says that both sexes are alike at this period, and probably they are; but this matters little, as until they have completed the first moult, the colour of the plumage goes for nothing. Young male after moulting (of course he means after the first moult in the autumn, after they have left the nest), "Red on the head, throat, and whole body, darker on the back and shoulders; old male, green or yellow on all parts where the foregoing are red."

Thus it will be seen that he never mentions the orange-red dress at all. He leads us to suppose that the red plumage is assumed on the first autumnal moult after the bird has left the nest; and that the standard adult plumage is, as he describes it, "green or yellow on all parts where the younger bird was red." He does not state here positively how long the red dress is worn, and from this description we should naturally conclude that the green-yellow dress of extreme age (and the reader must not confound this with the orange-red and yellow plumage of what I consider the young birds after their first autumnal moult) is assumed at the end of the second year.

In a note he adds, "The males can breed before they have attained their standard dress. We therefore find red as well as yellow males breeding." That we certainly do; but these yellow males to which he alludes I can prove satisfactorily to be young birds of the *second* year, and before they have obtained their red dress, and not, as he would imply, males that have changed from red to yellow. I certainly once, and only once, did shoot a very old yellow-green parrot crossbill from the nest, and I fancy this was a bird many years old.

He says that, besides the great change which the males

undergo at the true moult (in autumn), they even change very much between the moults; and this is certainly the case.

Wilson, the American ornithologist, describes the American crossbill, which both he and Audubon, however, consider as distinct from the European bird; and, as we might expect, from his being a field and not a chamber naturalist, comes nearer to the mark in his description when he says, "That the young males are during the first season mixed with ash, then bright greenish yellow, intermixed with spots of dusky olive, all of which yellow plumage becomes in the second year of a light red, having the edges of the tail inclining to yellow." He describes the male in perfect plumage as—General colour red lead, brightish on the rump, intermixed with touches of olive.

Sir W. Jardine, in a note to his edition of Wilson, remarks, "Our author is incorrect in stating that the young males, as is usual with other birds, much resemble the female. In fact, the young of all the crossbills, as well as of the pine grosbeak, contrary to the habit of the generality of birds, lose their red colour as they advance in age, instead of gaining an additional brilliancy of plumage. The figure which our author gives as that of an adult male represents a young bird of about one year old, and his supposed female is a remarkably fine adult male." Now I do not agree with Sir W. Jardine. I contend, and I can prove it, that the red standard livery of the male crossbill (at least that which is worn the longest) becomes brighter and deeper with age; and, moreover, that it is not assumed until the second or third autumnal moult. That the old male crossbill will eventually become bright yellow green, if allowed to live long enough, I will allow. I never, however, saw a crossbill, at any age, like the coloured figure in Wilson, to which Sir William refers; and as for his red male, instead of being a bird one year old, I consider it at least two, and more probably three years old.

Now, if the reader will attentively peruse the above descriptions, he will gather the fact, that the male crossbill is subject to a very great variation in plumage—yellow, orange, red, scarlet, and olive-green—but nothing more. He will not be able to form the least idea at what ages these different plumages are assumed; and his inference will most probably be this, that the old male crossbills have no regularly-defined plumage, but that birds of the same age are as likely to be yellow-orange as red, olive as scarlet. But this is far from being the case. The change of plumage is constant and regular as in any other birds; and I think we can prove that the males have four distinct and clearly-defined dresses following each other with the age of the bird.

Although we can hardly yet offer any certain data to prove

exactly at what age these dresses are assumed, I fancy we can form a tolerably good idea; and I will now proceed to state below, clearly and concisely, the four different stages of plumage which the male crossbill undergoes from birth to very old age. I have paid careful attention to this subject, and I write this with more than fifty packed skins lying before me, all shot here between the 1st of November and the 1st of April, in every stage of plumage, intermediate as well as determined. We will now shortly describe them.

The first dress after just leaving the nest, up to the first autumnal moult, has been correctly described as greenish brown, with dark longitudinal streaks down each feather. In this plumage there is very little difference between the male and female. In the nest plumage the beaks are straight, but the mandibles soon begin to cross after leaving the nest; and in the young birds of the year, killed early in November, the beak is nearly as much crooked as in the older ones. Sometimes the point of the under mandible crosses to the right, but oftener to the left.

As soon as the autumnal moult is completed, the females are easily distinguished from the males. The young feathers (striped) are very apparent in both, but all the under parts are tinged in the young males with yellow orange; in the females with bright yellow. The heads and rumps of the males are orange; in the females, the same parts are only slightly tinged with yellow.

In not one single young male, shot during the autumn or winter, have I seen the slightest indication to lead me to suppose that he would become red before the next autumnal moult, if then. It seems, however, very probable that this orange colour gradually becomes redder without a regular moult; but so much do the shades vary that we scarcely see two birds exactly alike. It would be difficult to say how long this plumage lasts, but I am inclined to think for at least one year, perhaps even for two, for early in November, long after the moulting was over, I have killed males of a beautiful orange male colour, which, from their eye and general appearance, could not have been birds of the year—at least there was a marked difference between them and young males which we knew to be birds of the year, killed at the same time, for in these latter half the plumage at least was composed of the dark-spotted young feathers. Still these larger finer-coloured birds might have been early birds born in the previous spring, although I think not. But that they breed in both these dresses I satisfactorily proved in the spring of 1863, when I took many nests, from which I shot orange males, and two of them I was certain were birds born in 1862, be-

cause so much of the dark streaked young plumage was remaining.

The plumage of the two birds which gave such unmistakeable proofs of being birds of the previous year, was greenish yellow-brown, tinged with orange on the rump and head, without the slightest approach to red. The other four, evidently older birds, were orange red; in two of them the colours very bright, and one was fast approaching to the deep red plumage; but still there is a marked difference between the reddest of these orange birds and the lightest coloured of twenty-five pure red birds which now lie before me. It is moreover, to my eye, very easy to trace the gradual change from the light orange yellow—which seems to be the first colour that mixes with the young plumage—to dark orange, and then deep red of the maturer bird. It is, I think, most probable that these fine orange birds were males in their third year, which would have become red had they lived to the next autumn. However this may be, I am pretty certain that anyone who saw my series of birds lying in a row, would agree with me that both these yellow and orange dresses are intermediate between the first plumage and the red dress; and in all the red birds there is little difference in the shading, except that in some the rumps are brighter than in the others; and in one or two a few green feathers may be seen shooting out among the red feathers on the back and head. In the summer the red colour is always dullest.

We now come to the third dress, for I consider this orange dress as nothing more than a transition from the yellow to the red. This is deep red. Brightest on the rump and head, blackish on the back, lightest on the belly—certainly purer and clearer in some birds than others, but pretty much the same in all; and this I consider the true standard livery of the male crossbill, but how long they wear it it is impossible to say—probably for two or three years.

Respecting the fourth, or bright yellow-green dress, which the very old male crossbills occasionally assume, but which, although so very rare that we scarcely see one of these bright yellow-green birds in a hundred, we must still, I think, admit to be normal (and this dress I fancy many naturalists have confounded with the yellow and orange dress of youth); it is very hard to say at what age it is assumed, but as we see so few of them, it is reasonable to suppose that it must be at a very advanced period of life, in a state of nature, although it would appear that so soon as either the crossbill or the pine grosbeak is confined in a cage, they change from red to this bright yellow livery, which they wear till they die. And I have seen an old male grosbeak, which was bright red when

he was caged in the winter, but at the next autumnal moult he changed to bright yellow-green—brightest on the rump and head—and which dress he has worn for ten years. This may, or may not, be the effect of confinement, but as I have killed one old male parrot crossbill in this dress, from his nest in the open forest, I do not hesitate to pronounce it normal. This latter dress is very different from the young yellow or orange dress first noticed.

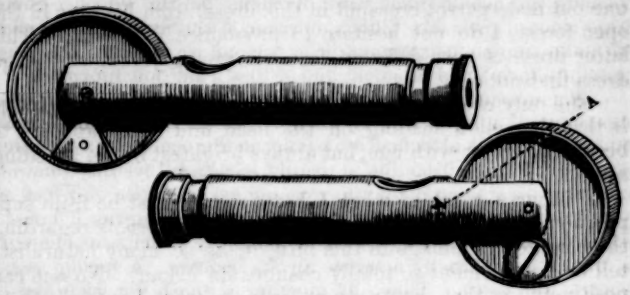
The only change that I can observe in the female crossbills is that the yellow shading on the head and rump appears to become brighter with age, but always brightest in the breeding season.

Of course, much of what I have stated must be from supposition, as it is impossible to obtain certain proofs regarding the change of plumage in this bird, if, as so many naturalists tell us, confinement so totally changes its colour. No one can positively say that these orange birds are what I suppose them to be—birds of the second or third year; but the young yellow birds which I shot from the nest, with more than half the dark young feathers remaining, clearly proved, at least to me, that the first plumage in the young male, after the spotted dress of youth, is not red, as has been erroneously stated, but yellow green; and the gradual change from yellow to orange, and from orange to deep red, is so marked in many of my specimens, that I have not the slightest doubt in my mind that the changes of plumage are as I have stated above. Still it is a subject I approach with diffidence, as it is one which has puzzled so many better naturalists than myself. However, in a case like the present, a man can but lay facts before his readers, and leave them to draw their own conclusions; and even if he is wrong there is no harm in his stating what conclusions he draws himself. The subject is a most interesting one, and I do not believe any naturalist has taken more pains to arrive at the truth than myself.

I must, before concluding, notice a rather singular fact, that in not one of all the birds I mention as being killed between October and April, did I observe a single blood feather, either yellow, orange, or red, as in the grosbeaks, which I shot in deep moult in August, or in the ptarmigan, which show blood feathers at every change of plumage. It proves, I fancy, that the moult was long over before I began to collect my specimens, and I fancy it goes also far to prove that a great part of the change takes place between the true moults by an actual change of colour.

A NEW ANGLE MEASURER.

BY THE REV. N. J. HEINEKEN.



THIS instrument, which I have lately contrived, is on the principle of Schmalcalder's quadrant, but of dimensions small enough for the waistcoat pocket. In the Schmalcalder, moreover, a prism is used for reading off the angle at the same time that the object is viewed. In mine, the divisions are read off by a lens, and a needle point, passing through the side of the tube, and close to the divided wheel, forms the index. The object is seen with the *other* eye at the *same time;* the instrument being elevated or depressed, till the needle point appears to be in contact with the object as well as with the division of the circle. The angle of altitude is thus indicated. The drawings are of full size. I add a description and measurements of the instrument. A flanged wheel $1\frac{1}{10}$ inch diameter, has one half and a little more divided into degrees, the surplus being for index error; edge of wheel $\frac{3}{10}$ wide; flange on each side about $\frac{7}{100}$ deep. Within this flange on one side is a large-headed screw of brass, and on the opposite side a triangular piece of copper to which it is attached. The screw passes through a slotted hole in the wheel. The screw and piece of copper form a counterpoise to the wheel, and the slot allows of adjustment of the Zero point.

A brass tube $2\frac{3}{10}$ long and $\frac{4}{10}$ diameter is filed out at one end so as to admit the above wheel, which is suspended as *delicately as possible* by a fine pointed screw on each side, the points of which screws enter a very fine hole, drilled in the axis of the wheel; upon the nicety of this suspension the accuracy of the instrument depends.

An aperture is made in the tube, near the wheel, to admit light for reading off the divisions, and moreover at this part the interior of the tube is silvered.

At A, a needle point passes through the side of the tube to furnish an index, as before stated.

The other end of the tube carries a lens of $1\frac{7}{10}$ focus, for viewing the needle point and divisions of the wheel. Some time since I gave Mr. Elliott, optician of the Strand, permission to make similar instruments if he wished to do so. He may possibly have some in stock, but of this I am not informed.

For measuring a short base line I use, with the angular instrument, a light rod of deal, 5 feet in length and $\frac{3}{4}$ inch square. This is attached by a joint at the centre to a walking stick.* A short base line is readily measured by this—merely marking by a scratch on the ground each length of 5 feet as you proceed. To register the number of lengths, I have a small toothed wheel, $2\frac{1}{2}$ inches in diameter, which is attached to a foundation plate by a screw in its centre. A spring catch enters the teeth. Thus, by moving a tooth for each ten or other lengths of the measuring rod, an accurate account is kept. Instead of the toothed wheel an account may be kept by shifting a number of marbles from one pocket to the other.

We hope the following hint may also be of service. Having made one of the reflecting levels (a very useful pocket-companion) described in Heather's *Treatise on Mathematical Instruments*, p. 120 (Weale), I had difficulty in making the line scratched on the mirror perfectly horizontal. This difficulty may be obviated by adopting a circular instead of a square shape for the centre of the instrument. In this a cell for the mirror may be turned, and it can then be adjusted with the greatest accuracy.

[We think Mr. Heineken's ingenious instrument might be improved by enabling *one* eye to view the object and read off the altitude on the scale. If the wheel and its supports occupied half the tube, and a knife edge or needle were stretched right across it, the eye, *looking through a hole* drilled in the centre of the lens at the eye-piece, would see the object, and be able to bring up the instrument so that it coincided with the knife edge, and the same eye looking through the lens would read off the magnified image of the scale. In this modification it would be better to have the tube square, as the wheel might then come very close to one side. Mr. Heineken finds that the error introduced by looking through the instrument with one eye, and at the object with the other, is very small, but we think, with most observers, it would be less with the modification suggested.]

* Mr. Heineken has sent us a drawing of this contrivance. The walking stick and the measuring rod, when not in use, fold together; when in use they open like an inverted capital T (⊥), and by holding the walking stick in the hand, and pressing the rod to the ground, the measure can be taken without stooping.

PROFESSOR HAUGHTON'S GEOLOGY.

A LITTLE while ago we had to speak very highly of a publication belonging to "Galbraith and Houghton's Scientific Manuals" — we mean Dr. Apjohn's *Manual of the Metalloids*—and our reason for commending that useful work was, that it formed a good introduction to chemical philosophy, as well as offered to students a compendious collection of well-assorted facts. In all sciences it is easy to discriminate between its philosophy and the real or supposed facts which form its basis, and out of which the philosophy must be evolved. Facts alone, however carefully collected and verified, do not constitute a science; they are only the bricks or stones with which the edifice must be built: and it is of more importance to acquire a sound method of reasoning, than simply to accumulate a large store of particulars, which must remain in the condition of the dry bones of knowledge until a philosophic informing spirit gives them organic relation and life. The more complex the science, the greater need of breadth and clearness of philosophical conception, and the greater need also to cultivate such a habit of prudent doubt, that while certain theories may be employed on the ground of their apparent probability, they may be held so lightly as to be discarded the moment a better theory can be obtained. Geology, as a science of remarkable complexity, stretching its roots on all sides, and making them ramify in all directions, from physics to biology, cannot be decently taught without a careful philosophy to accompany the learner at every step. In no one department does geology—as at present known—present its votaries with a complete cycle of facts. The physics of the globe are yet sadly incomplete, and our information is exceedingly small concerning the condition of the inner portions of our planet. The chemistry of geology is likewise in its infancy, and few questions of importance respecting the chemical formation of rocks have been fairly solved. Equally incomplete is the biology of geology. As former articles in this work have shown, the stone record is exceedingly imperfect, and thus we have nothing approaching to a complete collection of the remains of the organized beings that occupied the globe at any given time, and the physiologist cannot supply us with biological laws of sufficient generality to justify a wide deductive reasoning capable of explaining the fragmentary groups of facts that we possess.

Another peculiarity of geology is its rapid growth, by which hypotheses are continually superannuated, and doctrines highly cherished to-day placed in such fresh lights that they

must be abandoned to-morrow by the sincere searcher after truth. Such a condition of science is, no doubt, awkward for a professor, because, if he is competent to his task, and performs it conscientiously, he must, at almost every step, warn his pupils against putting implicit faith in the opinions he may express. A good set of lectures on geology, or a good book on the subject, should not only explain the latest important facts and modifications of theory, but prepare the student for the reception of fresh facts that may militate against opinions that appear fairly established upon satisfactory grounds. The history of science is that of a series of surprises. A few great men may usually have had glimpses, or intimations, of forthcoming truth; but the general tendency of discovery is to startle the mind with unexpected verities, that wage vigorous warfare against existing ideas.

A good manual of geology would have been a real boon to the student public, because, notwithstanding the great merit of existing works, and especially those of Sir C. Lyell, it would be impossible to name a single volume in which the present aspects of the science are compendiously displayed. That the Rev. Samuel Haughton* has not succeeded in supplying this want, partly arises from some personal peculiarities, and partly from the obvious fact that in the work before us he has not done justice to his own powers. The course of lectures out of which his *Manual of Geology* has been compiled could scarcely have been prepared with express view of the use now made of it, and thus there is much to object to in the plan of the work. Its chief fault, however, is its remarkable omission of important facts, of recent date in the order of their discovery, and an equally remarkable omission of philosophical doubt and prudent caution in dealing with the theoretical parts of the subject.

Like Diedrick Knickerbocker, in his never to be forgotten *History of New York from the beginning of the World to the end of the Dutch Dynasty*, Mr. Haughton commences with a cosmogony. He accepts as probable, and in accordance with the views of most scientific men, the "nebular hypothesis," and he conceives our globe to have slowly cooled down, from the condition of a widely-diffused gaseous body to that of a compact little world. To this we have nothing to object; but he treats certain theories of M. Durocher, to which grave objections might be made, as if the suppositions of that ingenious gentleman were to be accepted as verified facts. M. Durocher, with that desire to present a neat round mode of accounting

* *Manual of Geology.* By the Rev. Samuel Haughton, M.D., F.R.S., Fellow of Trinity College, and Professor of Geology in the University of Dublin. Longmans.

for everything, which often charms his rapidly generalizing countrymen, tells us, according to Mr. Haughton's translation, "that the first and second layers of the globe are composed of totally different materials. The outer layer, which he calls the Acid Magma, corresponds with the granites; and the inner, or second layer, which he calls the Basic Magma, corresponds with the trap rocks and greenstones." If the various components of granites are lumped together, it appears that they contain about 71 per cent. of silica, while the rocks belonging to the so-called Basic Magma series contain about 51 per cent.; the quantity of oxygen in the two cases is represented by the figures 48·22 and 43·60 respectively. We do not deny that M. Durocher has something to say in favour of his supposition, that under the hardened crust of the globe are his two *fluid magmas;* but it seems to us rash in Professor Haughton to exclaim, "we adopt then, as chemical geologists, Durocher's hypothesis as to the first and second layers of the globe." M. Durocher writes on the proceedings of his magmas with all the confidence of an eye-witness who was comfortably situated so as to watch the condensation of nebulous matter, and its assumption of terrestrial form. He says, according to Mr. Haughton's translation of his paper, "the first pellicle that solidified on the surface of the yet incandescent globe was evidently formed by the uppermost layer, the lightest and the most fusible; thence resulted the primitive granite." How do we know anything about the *first pellicle* of our globe? Who has an authentic bit of it, and where is it to be found? In his text, Professor Haughton appears to tell us where to find it; but in a more cautious appendix he leaves us quite at sea. The text of the *Manual* says, "as the globe cooled, we know that fissures formed in it, evidence of which fissures still remains in our mountain chains and metallic lodes."

Now is there a particle of proof that the fissures in the terrestrial surface which now appear, were made in the earliest days of the earth's existence as a solidifying planet? Professor Haughton apparently saw the doubt that must arise in most minds against M. Durocher's assumptions, and accordingly in Appendix B he says, that although he has adopted in the text Durocher's theory of the granitic and trappean magmas, yet he does not believe that "any trace of these primitive magmas can be found." But if no trace exists of the first portion of solidified magma, how can the *fissures* thereof remain unto this day? We can understand a cracked plate; but we should be surprised to see the "fissures" after all trace of the plate had disappeared. It is evident that in this case Professor Haughton shows to better advantage in his appendix than in his text, and if he had gone a little further, suppressed

the text, and made the work *all appendix*, we have no doubt he would have done greater justice to his acquirements and powers. We have proof of this when we compare the remarks on geological time made in the fourth lecture with the opposite remarks which the appendix affords.

In the text, Professor W. Thompson's allowance of time, based upon calculations as to how long the sun may have been shining upon our earth, if certain assumed conditions are correct, is stated to be "very liberal," and geologists are soundly rated for not being contented with one, or even five hundred millions of years; while in the appendix we find Professor Haughton making an elaborate computation according to a formula of Helmholz—who thought to solve the difficulty by inquiring how long it would take for the earth to cool down from an incandescent state to a temperature at which any organic being we are acquainted with could live—and finding that 1280 millions of years would elapse as the time of cooling from 122° to 77°. Commenting on these figures, the Professor says, "Vast as the period of 1280 millions of years must appear to us, yet the globe was habitable, in parts at least, for a longer period, for the polar temperature would have admitted of the existence of animal life before it was possible in Britain, and it is also highly probable that the rate of cooling of the earth was slower than is here assumed."

If we pass from this part of the subject to the zoology and palæontology of Mr. Haughton's manual, we find ourselves unable to applaud the text, and without the consolation of finding it handsomely contradicted in the appendix.

In speaking of the Foraminifers, Professor Haughton proceeds as if Carpenter, Jones, and Parker had not commenced their well-known labours, and he accordingly follows a method of division in which the arrangement of the cells, whether rectilinear, spiral, or irregular, is made the basis of classification. Much information on this subject will be found in the admirable paper from the pen of Dr. Carpenter, which we published in our vol. vii., p. 278;* and we may cite a passage from the last edition of his work on the microscope, in which he states that, "plan of growth is a character of very subordinate importance among the foraminifera, and that any classification which is primarily based upon it must necessarily be altogether unnatural."

Professor Haughton gives a representation of the *Pteryyotus acuminatus*, or as it is now called *Slimonia acuminata*, and it is a pity that in this case he did not refer to the specimens obtained more than two years ago by the British Museum, from

* "On the Structure, Affinities, and Geological Position of the Eozoon Canadense."

which Mr. H. Woodward made an excellent drawing, which we published in November, 1863.

A student not duly cautioned against the deficiencies of Professor Haughton's book would be grievously misled by his remarks on the total thicknesses of different strata, and the periods of geological time which they represent. He takes what he calls "Azoic rocks," in which he seems to include the formation containing the *Eozoon Canadense*, to be 4·333 geographical miles thick, the Lower Palæozoic 5·082, the Upper Palæozoic 4·458, and the Neozoic 4·512; and as these figures approximately coincide, he says, "It is therefore exceedingly probable that these four great periods of the earth's history are of nearly equal value in point of duration." In this calculation no notice is taken of the breaks in the succession of the various strata, and the consequent gaps in the records which the geologist has to decipher. If we knew from physical reasons, that at a given number of millions of years ago every portion of our globe was too hot for the existence of any organized creatures analogous to those now living upon it, we should be justified in stating that previous to that time all formations would belong to the lifeless or Azoic age; but notwithstanding the repeated proof of the vanity of arriving at this class of positive decision upon merely negative evidence, Professor Haughton endeavours to fix in the minds of his pupils a philosophy which is obviously unsound. It happens, and may happen to an extent far greater than is yet known, that leaves and chapters of the Stone Book, wanting in some editions, may be supplied in others—that is to say, for example, that strata omitted in England are or may be detected elsewhere; but there is little hope that a complete series will be made out, and as the matter at present stands, the gaps are of immense importance when we have to consider either the time spaces represented by groups of formations, or the changes that have been experienced by the organic life of the globe.* Professor Huxley has shown that it is common to make a great exaggeration in speaking of the differences that are traceable when existing plants and animals are compared with those of past geological epochs. He says,† "We are all accustomed to speak of the number and extent of the changes in the living population of the globe during geological time, as something enormous; and indeed they are so, if we regard only the negative differences which separate the older rocks from the more modern, and if we look upon specific and generic changes as great changes, which from one point of view they truly are. But leaving the negative differences out of con-

* See "Missing Chapters of Geological History," in our vol. vi., p. 12.

† *Quarterly Journal Geological Society*, May, 1862, p. xlviii.

sideration, and looking only at the positive data furnished by the fossil world from a broader point of view—from that of the comparative anatomist who has made the study of the greater modifications of the animal form his chief business—a surprise of another kind dawns upon his mind; and under this aspect the *smallness* of the total change becomes as astonishing as was its greatness under the other." Professor Huxley then points out, that no new *ordinal* type of vegetable structure has been discovered in a fossil state, and that "no fossil animal is so distinct from those now living as to be arranged even in a separate class from those which contain existing forms."

A philosophy of geology which takes no notice of this class of fact is deplorably incomplete. It is of the utmost importance, when speculating upon the discordance between the organic life of one period and that of another, to consider all evidence, whether negative or positive, that indicates the probability of the change having been of a slow and gradual kind. Professor Haughton does not feel this. He considers that the modifications of the globe from the nebulous to the solid form, and thence through various changes brought about by physical and chemical agencies, to the condition in which we find it, have resulted from the operation of natural laws; but he refers all changes in organic life to the "*arbitrary* will of the Creator," by which we presume he means a kind of will distinct from that which is manifested in the operations of unorganized matter, in which law and intelligible order prevail. This is a most unfortunate attempt to place a theological barrier in the way of scientific inquiry. It practically tells man that he may profitably endeavour to trace the *physical* changes of the globe; in them he will see the operations of a will acting upon methods he may hope to some extent to understand; but that the moment he comes to the simplest living creature, he is in contact with another kind of will, which being "arbitrary," cannot possibly be understood. Real science makes no such distinctions. It perceives no traces of will without reason, and when it finds itself baffled by the complexity of phenomena, it does not conceive that there is anything in them more "arbitrary" than in the more obvious sequences of cause and effect.

We have cited Huxley on the question of life-changes on the globe, and we dismiss this part of the subject by a parallel quotation from Ramsay, who says, in reference to the relative position of strata and the distribution of life, "I cannot resist the general inference that in cases of superposition, in proportion as the species are more or less continuous, that is to say, as the break in life is partial or complete, first in the species,

but more importantly in the loss of old and the appearance of new or unallied genera, so was the interval of time, shorter or longer, that elapsed between the close of the lower and the commencement of the upper formation; and so it often happens that strata a few yards in thickness, or, more notably still, *the absence of these strata*, may serve to indicate a period of time as great as the vast accumulation of the whole Silurian series."

Professor Haughton is decidedly reckless in the assertion that whenever a creature deviates from the original type, the result is a "monstrosity," and an imperfection, and "not an advantage." If Mr. Haughton selected any kind of dog as his original type, how could he demonstrate anything of the kind? He might show that particular breeds of dogs were only capable of preservation under conditions of considerable care and attention; but it would not be true that spaniels, or terriers, or hounds ought to be regarded as "monstrosities," exhibiting "imperfections" and disadvantages just so far as they differed from his original type. The pigeon fancier might point to hardy and delicate varieties; but could he not find two or more varieties, differing considerably from each other, and differing from the supposed primitive type, and yet healthy and strong? We do not believe that *all* departures from particular types involve iimperfection. That some deviations are altogether mischievous we do not deny, and others serve a particular purpose at a special expense of injury in another direction. Our gardeners have however supplied us with abundance of healthy varieties of plants, and our breeders have assuredly produced healthy varieties of stock.

We are sorry that we cannot speak more favourably of Mr. Haughton's *Manual of Geology*. In many matters of detail his acquaintance with specialities may show to advantage; but on the whole the book is a failure, the more unfortunate from the position and reputation of its author.

DAVAINE ON VINEGAR EELS.

M. Davaine has a paper on the Vinegar Eel, *Anguillula aceti*, as it is usually called by microscopists, or *Rhabditis aceti* of Dujardin, in *Comptes Rendus*, No. 6, 1865, in which he states, "Acidity is not a condition necessary to the existence of the vinegar eels. Mineral acids, oxalic, acetic, and citric acids, diluted with pure water to the degree of the vinegar in which the eels live, cause them to perish in a few hours or in a few days; on the other hand they live and propagate rapidly in a non-acid liquid if it contains sugar. In pure water the Anguillula perishes in about a week; but will live for several weeks if one or two thousandth parts of sugar is added, and several months if three to five thousandth parts are introduced. In water containing five per cent. of sugar they perpetuate themselves and multiply in great numbers. Their multiplication seems to stand in relation to the quantity of sugar; it augments notably up to 30 per cent.; at 40 per cent. it remains stationary; while in water containing 50 per cent. they no longer increase but perish.

"In a few days the sugar-water becomes sour through the formation of lactic acid; but this acidity may be neutralized by placing in the vessel a thick layer of powdered chalk. The Anguillulæ then multiply to a greater extent than in an acid liquid.

"Guided by these results," says M. Davaine, "I placed some Anguillulæ in fruits that were neutral or slightly acid, such as peaches, prunes, apricots, grapes, cherries, gooseberries, apples, pears, melons, etc., and in every case they multiplied prodigiously; their fecundity being in relation to the quantity of sugar present, beetroot and onions standing in the first rank, then carrots and tomatoes, and lastly turnips.

"The Anguillulæ grown in these different materials did not experience any modification, and in flour paste, where they have ample nourishment and increase prodigiously, they do not differ in length, thickness, or aspect.

"These facts appear to indicate clearly the native country of the vinegar eel; it lives and multiplies by the million in fruits which fall to the ground, and in the saccharine roots growing in the soil. To enable them to seek this food they are endowed with a well-developed faculty of locomotion, and they can live more than three weeks in moist earth without any other nourishment."

M. Davaine adds that these Anguillulæ live exclusively in vinegar obtained from fruit.

CLUSTERS AND NEBULÆ.—DOUBLE STARS.—OCCULTATIONS.

BY THE REV. T. W. WEBB, A.M., F.R.A.S.

THE rapidly-shortening days, however we may regret the loss of out-door pleasures, bring their compensation to the astronomical student in the increased opportunities of searching for nebulæ, and discovering the footsteps of the Creator's glory in his more distant and, at any rate, less conspicuous works. To these, therefore, we shall now re-conduct our readers, enlarging, at the same time, our list of Double Stars, which has long remained in a stationary condition.

We begin with an object so intrinsically marvellous, that we can but regret that so few amateurs are likely to be in possession of the means of developing its structure. As in many other cases, however, it will be interesting merely to look *at* that which more fortunate observers are permitted to look *into*. They, too, in turn, will have their own regret that they are unable to look *through* a wonder, the true nature of which is, notwithstanding, in all probability inaccessible to mortal gaze. This is

29. *The Great Spiral Nebula in Canes Venatici.* 51 M. To find this, we must first get the bright star at the tip of the Great Bear's tail, *η Ursæ Majoris*, alias *Al Kaid* (sometimes called *Benetnasch*). Nearly 2° (of arc, not of R.A., which makes a material difference in these circumpolar regions) *p* this, lies a 5-mag. star, 24 in *Canes Venatici*, or simply 24 *Canum*, the plural form sufficiently indicating that it does not belong to either *Canis Major* or *Minor*. *sp* this, we shall notice an open triangle of much smaller stars, and just *p* the star at the S. angle (or 2° *s*, a little *p*, from 24 *Canum*), a finder of 1¼-inch aperture will show a dull and feebly visible patch. Powers of 30 and 65 upon 5½ inches show a double nebula in contact, the larger one about four times the size of the smaller; each possessing a sharp nucleus of nearly equal intensity. With steady gazing, the larger nebulosity shows some feeble traces of convolutions or indistinct irregularities. A power of only 111 proved already too high for its faint and misty light. Messier, the discoverer in 1772, failed, as might be expected, in doing more than perceiving the duplicity and contact, and measuring the central distance. ♅ first perceived that one of the nuclei was surrounded by a distant halo or glory, which, in fact, forms the exterior edge of the larger nebula, as seen in ordinary telescopes. His son detected and drew a "partial subdivision of this ring into two branches throughout its *sf* limb," and thought it might resemble our

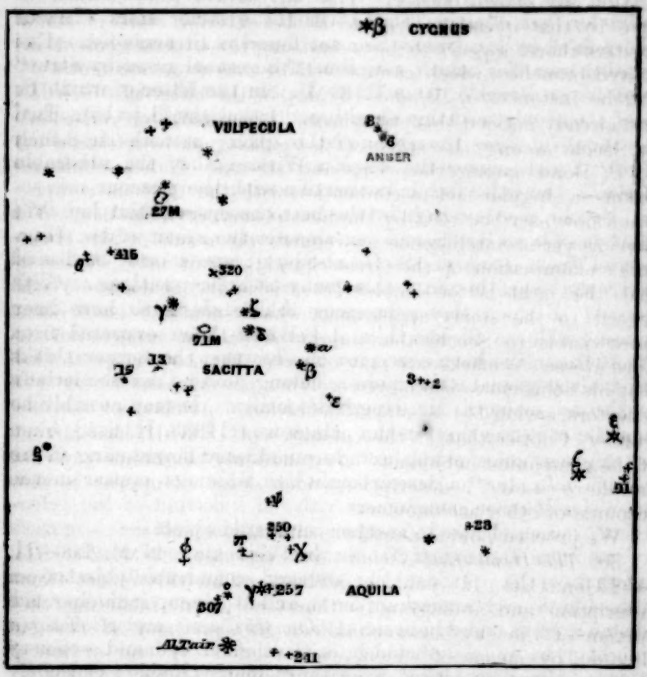
similarly divided galaxy in its construction. "Can it then be," he asks, "that we have here a brother-system bearing a real physical resemblance and strong analogy of structure to our own?" But what an astonishing disclosure of a spiral convolution has here been made by the 6-foot mirror of the Earl of Rosse is now so well known through the multiplication of representations (not all of them, it may be feared, much like the original!), that it need not be enlarged upon here. Our readers will, however, be glad to be made acquainted with that great observer's comments. After having remarked that Herschel II.'s figure of the partially split ring, taken with a "front-view," and therefore reversed right and left only, requires to be inverted also before it will correspond with the Newtonian image of his reflector, he proceeds, "We thus observe that with each successive increase of optical power the structure has become more complicated and more unlike anything which we could picture to ourselves as the result of any form of dynamical law of which we find a counterpart in our system. The connection of the companion with the greater nebula, of which there is not the least doubt, and in the way represented in the sketch, adds, as it appears to me, if possible, to the difficulty of forming any conceivable hypothesis. That such a system should exist, without internal movement, seems to be in the highest degree improbable: we may possibly aid our conceptions by coupling with the idea of motion that of a resisting medium; but we cannot regard such a system in any way as a case of mere statical equilibrium. Measurements, therefore, are of the highest interest, but, unfortunately, they are attended with great difficulties. Measurements of the points of maximum brightness in the mottling of the different convolutions must necessarily be very loose; for although on the finest nights we see them breaking up into stars, the exceedingly minute stars cannot be seen steadily, and to identify one in each case would be impossible with our present means." The central nucleus he saw clearly resolved with his smaller speculum of 3 feet in diameter, and the 6-feet showed the spirality of the principal nucleus very plain, and a spiral arrangement in the smaller nucleus, and he thought that considerably less power would suffice on a very fine night to bring out the principal convolutions. Accordingly this impression has been verified by Secchi, who with $9\frac{1}{2}$ inches of aperture in the Roman sky was able to attest the great accuracy of the Earl's representation. He succeeded in tracing very fairly the two branches of the spiral, and in detecting many stars; but whether in, or only in front of, the nebulosity, he leaves undecided. He has noticed it as a peculiarity that it will not bear magnifying power. His mea-

sures give, for 1855·448, position 15°·54; distance 4′ 22″·78. This wonderful object, which stands as No. 1622 in H.'s catalogue of 1833, and 3572 in the General Catalogue, is the leader of the marvellous class of *spiral nebulæ* of which the Earl of Rosse had, up to 1850, discovered 14, with suspicions of others, and concerning which he remarks, that "the question may perhaps suggest itself, whether there is not something in the aspect of a spiral nebula which forces upon us the conviction that it is a system with an organization quite different from that of any known cluster. The only answer I am enabled to give to that question is, that in the exterior stars of some clusters there appears to be a tendency to an arrangement in curved branches, which cannot well be unreal or accidental;" and he instances 5, 10, and 13 M.; in the latter of which H. had already noticed this structure. It has also been remarked by Secchi among the stars of the galaxy, and was traced by G. P. Bond among the wisps and streaks of the nebula in Orion—a singular fact in connection with the gaseous composition now ascribed to it by the best observers of the day. We have as yet no intelligence as regards the result of Mr. Huggins's examination of the Great Spiral; and it may be feared that the light is too feeble for satisfactory analysis. With regard to the starry appearance, which seems to have been more visible to Secchi than might have been expected from Lord Rosse's remarks, we may observe that the former thinks that his achromatic has more resolving power than the latter's reflectors, owing to its superb definition. It may possibly be worthy of notice that, in the catalogue of 1833, H. has spoken of the companion nebula as "very suddenly brightening in the middle to a star," a description which does not appear in the accounts of other astronomers.

We proceed now to another celebrated object—

30. *The Dumb-Bell Nebula in Vulpecula.* 27 M. 2060 H. 4532 Gen. Cat. It would be difficult to find this object from description, and a diagram is therefore given, including the portion of the sky between *Albireo* (*β Cygni*) and *Al Tair* (*α Aquilæ*), by means of which, with a good eye and ordinary finder, it may be picked up without much trouble; especially after the student has carefully noted the four leading stars of the little constellation *Sagitta α, β, δ, γ*; about 3° N. of the latter, inclining a very little to the E., a keen sight will catch a 5-mag. star, 14 *Vulpeculæ*, just *sf* which the nebula will be detected, though not readily, with a finder of 1¼ inch aperture. With 5¼ inches and a power of 65 it is a comparatively brilliant mass of luminous haze, divided into two contiguous oval lobes, on either side attended with much irregular scattered light, involving a 10-mag. star, *p* the S. end. ♅, who seems to have

noticed only the more luminous part, described it as of a mottled aspect. H. filled up the notches with feebler nebulosity projecting on either side so as to complete an ellipse, or possibly an elliptical ring, at right angles to the direction of the two bright lobes. The longest diameter he found 7′ or 8′. He considered it not resolvable, but perceived in it four stars of 12, 12—13, 13, and 14—15 mags. The S. head was a very little the denser of the two. The Earl of Rosse's 3-foot mirror somewhat varied this form, by giving to one lobe a wide exten-



sion on either side, in which shape it has been long before the public. He found it a difficult object, requiring an extremely fine night and tolerably high power, when it was "seen to consist of innumerable stars, mixed with nebulosity." The 6-foot speculum again changed its aspect, showing a greater variety of details, and especially a narrow detached stripe of faint light bordering much of the circumference, and extending one end of the oval into a point, so as to give the whole a rude resemblance to a widely-opened eye. The resolvability does

not, however, seem to have been increased. In the autumns of 1850 and 1851 the positions of twenty-one stars were measured by his lordship's assistant, Mr. Bindon Stoney, and very many more were distinctly seen, but not inserted in his sketch. The powers employed were low, the number of stars visible depending, he says, even more upon magnifying power and distinctness than aperture. Several of those in his diagram lie, as might be expected, much outside the extent of the nebula in smaller instruments. O. Struve had previously measured twenty-five stars with a power of 207 in the great Poulkowa refractor, possibly not exactly within the same limits. Six of those fixed by Mr. Stoney are not found in Struve's list. Excepting one of 8 mag. (= 8¼ Sm.) the rest as given by Struve range from 10—11 (about 12 to 14 Sm.) to 13 mag. (= 20 or less); one only reaching 10—11, and two others 11 (=15). Two or three of these I was enabled to pick out with an 8-inch silvered glass speculum, by Mr. With. They are admirable tests for the light and definition of a superior telescope.

Secchi, whose design is in some sense intermediate between the two of Lord Rosse, and contains nearly as many stars, sees a few of them steadily, but the rest by glimpses only, and it is not surprising, therefore, that many of their positions are different. Besides these, he sees the bright lobes and their uniting isthmus all dotted, and believes their composition to be stellar. We have every reason, however, to suppose that all the recognized starry points belong to the dense myriads of the galaxy, since Mr. Huggins's analysis, instead of exhibiting the continuous spectrum which would have resulted from an aggregation of stars, brought out, from different parts of the nebula alike, but one single bright line, which "was ascertained, by a simultaneous comparison with the spectrum of the [electrical] induction spark, to agree in position with the brightest of the lines of nitrogen." So that this gaseous wonder—for all that can be proved to the contrary—may actually lie far on this side those glimmering points, and at a comparatively small distance from our own system. On this account, as changes might possibly be detected in it, Secchi's measures become of value. He gives, for the lesser diameter, 1′ 44″·44; for its position 6°; for that of the longer axis 97°. H. had found, about twenty years previously, 31°·4 and 117°·1 for these respective angles; but with a form so unmeasurable, and observed with such different instruments, it is obvious that nothing could be inferred excepting from a much wider discordance.

Our next will be a much more intelligible, though less interesting object—

31. 71 M. (*Sagittæ*). This will be found with little trouble from γ and δ, as shown in the diagram. If we start from γ, an

orange 4-mag. star, we shall find, something less than 2° *p*, a little *s*, a number of small stars, forming a very fine group in a large field; just *f* this, we catch a faint cloud, which readily yields up its stellar components to increasing power. It is 4520 of Gen. Cat., 2056 H. (1833), who says it fills his field (15′), but occupies 3′ with its most condensed part, which is of an acute triangular form; the stars ranging from 11 to 16 mags.

DOUBLE STARS.

The little map which has served as a guide to the two preceding objects will also aid us materially in discovering a number of pairs, which would otherwise, from their minuteness or their position, have been omitted from our list. In order to keep the diagram more clear, no *numbers* are affixed, excepting to the stars which we are about to examine, and those referring to Piazzi's catalogue are abbreviated by the omission of his initial and hour. Beginning from the N., where *Albireo* (*β Cygni*) is conspicuous, we come first to—

135. 6 and 8 *Anseris*, a noble wide 4 and 5 mag. pair, not in Sm.; both orange; the larger a very fine colour. There are three other little pairs, and many small stars, included in a very beautiful low-power field. Next we take—

136. *θ Sagittæ*, a triple group. 11″·4 and 70″·1. 327°·1 and 226°·6. 7, 8, and 9. Pale topaz, grey, and pearly yellow. This very pretty combination, which lies in a fine field, is readily found by carrying a line from δ through γ as far again. Nearly 1° *np θ*, but much more *p* than *n*, being the first star in that direction in the finder, where it is just visible, we come upon—

137. 415 P. XIX. *Vulpeculæ*. 4″·5. 340°·5. 8 and 10. Pale white and sky blue (1838·7). This pretty pair is in "a fine galaxy splash of stars." The larger star, or in observatory language A, appeared reddish to me, 1864·8. Both components are visible with 65, but it is very minute and delicate. Sm. considers it stationary, but Secchi thinks it may be in motion.

Reverting to *γ Sagittæ*, we shall perceive in the finder about 2° *np*, a little triangle of 7-mag. stars, of which the two lying *p*, 299 and 301 P. XIX, are comparatively near together; the hindmost is double, being—

138. 320 P. XIX. *Vulpeculæ*. 42″·7. 147°·6. Both 7. White. This is a peculiarly beautiful open pair, probably stationary. In the same field, *p* a little *s*, I noticed a pretty group, consisting of a smaller, closer, and more unequal pair, followed by a very minute star nearly in the same line.

δ *Sagittæ*, 4 mag., is worth looking at for its fine orange-

yellow colour—a hue which in a minor degree predominates in this region, being noticeable in α, β, γ, and η of this constellation,* besides others which come before us as pairs. δ is also beautifully situated in a rich galaxy region full of glorious combinations of minute stars. But we are now about to use it as a pointer to the next object, lying a little way *nf*—

139. ζ *Sagittæ*. 8″·6. 312°·3. 5 and 9. Silvery or flushed white and cerulean blue; improving greatly under red illumination. A pretty double star.

13 and 15 *Sagittæ* (not in Sm.) will both repay the finding, as the centres of fine groups, especially the former, in which the *lucida* is of a fine orange, while a smaller one is very red.

140. ϵ *Sagittæ*. 1′ 32″·2. 80°·9. 6 and 8. Faint yellow and bluish. This wide but pleasing object may be found by means of α and β.

141. 2 and 3 *Sagittæ* (not in Sm.) These two 6-mag. stars, of which 2 is considerably the larger, form a fine wide pair. Both are white.

We now proceed into the constellation *Aquila*. In looking westward from *Al Tair*, a little *n*, across the intervening dark space to the *p* branch of the Milky Way, we see two tolerably conspicuous stars, ζ and ϵ *Aquilæ*, both 3 mag. according to the S.D.U.K. star maps, although ϵ seems very small for that magnitude. This star is pale orange, ζ being pale yellow. In the field with ϵ, *sf*, but much more *s* than *f*, is our next pair—

142. 263 P. XVIII. *Aquilæ*. 6″·5. 289°·1. $8\frac{1}{2}$ and $10\frac{1}{2}$. Pale yellow and sapphire blue. This pair seems to be only optical: it is called a "handsome test object" by Sm., that is, of course, for the light of smaller instruments. I noticed another star, as minute as the *comes*, a little way *n f*.

A short distance S. of ϵ and W. of ζ we shall perceive, in the finder, two small stars. The *n* of these, 10 *Aquilæ*, 6 mag., is in a remarkable neighbourhood, being closely preceded by a curiously arranged group of small stars, and followed at a greater distance by another scattered group. There is so much similarity of magnitude in these little assemblages as to convey the impression of mutual relation and dependence. The *s* of the two stars is our next object—

143. 11 *Aquilæ*. 19″·1. 240°·9. 7 and 10. Pale white and smalt blue (1832·61). I thought A yellow, 1850·7, 1864·76, 1865·63. So Dembowski, 1863·48. Σ called it greenish white, 1831·31. Sm. would have rated A 6 mag., Σ, 5·7, Demb. 5. His measures are 17″·427. 252°·15.

About two-thirds of the distance from *Al Tair* to ζ, we shall meet with another pair. In the finder a triangle of

* It is somewhat remarkable, as Sm. has observed, that so unimportant a group of stars should have been so early formed into a separate constellation.

6-mag. stars will be seen, followed by two other similar ones. The most *n* star of the triangle is—

144. 28 *Aquilæ*. 59″·8. 175°·7. 6 and 10. Dusky white and lilac blue. I noticed a minute pair, perhaps 10½ and 11 mags., somewhat wider, at a little distance *f*.

We must now advance into an intricate and puzzling region, *n p Al Tair*, where we must "keep a bright look out," or we shall be likely to miss some objects of interest. Few of the stars in this neighbourhood exceed 6 mag., and therefore any dulness of vision or atmosphere will greatly increase our difficulty. A careful study of the district with the finder will however enable us in a short time to master it all. We may as well begin with a little group (appearing as a small vertical pair in the finder), lying about midway between *Al Tair* and *α* and *β Sagittæ*, as always easy of recognition, from its peculiar character, though the *lucida* is inferior to several of its neighbours: it is also intrinsically a pleasing object, three stars forming a nearly vertical line: the furthest *n*, 6 mag. according to Star Map, but certainly small for that rating, white; this is *ψ Aquilæ*:—the central star 9 mag., perhaps purplish:—the *s*, 8 mag., orange or rosy, 255 P. XIX. We will next identify *χ Aquilæ*, a yellow star of a good 6 mag., and therefore fairly visible to an ordinary sight; a line drawn from *Al Tair* through its conspicuous and well-known 3-mag. companion *n p*, *γ Aquilæ*, alias *Tarazed*, points to it at about an equal distance beyond. Now between this *χ*, and *ψ* just mentioned, but a little E. of the line, we find—

145. 250 P. XIX. *Aquilæ*. 20″. 312°. 8½ and 14. White and blue. This pair possesses considerable interest from the probability that the attendant may be variable. Sm. calls it "an excellent test object," but it has certainly ceased to deserve that appellation, the smaller star now considerably outshining the *comes* of 257 P. XIX. (to be described presently as No. 147), which Sm. rates 10 mag. My attention was drawn to its unexpected size by a correspondent in 1862, and Mr. Knott found it, 1862·56, about 10·2, and visible even with 1¼ inch of his great equatorial. Struve also rates it 9·5, corresponding to 10¼ Sm. The possibility of any mistake or misprint in the Bedford Catalogue is obviated by its description as a "test object," which it could not be in any other respect but that of *light*; and any suspicion of passing haze at the time is removed by the agreement of Sm.'s estimate of the mag. of A with those of Struve and Knott. It well deserves, therefore, to be attended to.

About 1½° E. of *χ*, and forming a tolerably equilateral triangle with *χ* and *γ*, or *χ* and *ψ*, we find—

146. *π Aquilæ*. 1″·7. 121°·3. 6 and 7. Pale white and

greenish. This "beautiful miniature of *a Geminorum*" was considered by Sm. and Σ to be fixed. Secchi, however, believes it to be in slow motion, from a comparison of the mean of his measures in 1855 and 1856, giving 1″·359, 118°·36, with Σ's, 1829·96, 1″·502, 120°·75. ℍ has 124°·4 in 1783. Σ made both stars yellowish; Secchi yellow and blue. I have remarked a very minute star, perhaps 14 mag., a short distance *n p*: a good test for light.

Before leaving this neighbourhood we shall point out a star about 1° *n p* ψ. It is easily recognized as one of the more conspicuous of the region, and larger than ψ, nevertheless it has been omitted both by Flamsteed and Piazzi, the latter of whom especially has inserted many minuter objects in the immediate vicinity. Mr. Knott informs me that it appears in Lalande's Catalogue as No. 37394, 6 mag., and as 7·8 mag. in Bessel's Zones, whence Wolfers has concluded that it may be possibly variable. Mr. Knott now judges it to be 5¾ or 6 mag., and remarks its peculiar whiteness; to me, however, it appears very slightly tinged with yellow. In the *Uranometria Nova* of Argelander it is marked as a naked eye star, and he rates it 5·8 mag. A little *n* there are two open pairs of 9 mag. stars near together, forming a pretty group.

We now return to γ, or *Tarazed*, partly to notice its very fine full yellow colour, which may be set down as Y² of Sm.'s notation in his *Sidereal Chromatics;* partly to point out a curious chain of small stars a little to the S. of it, with a double flexure, reminding us of Secchi's curves in the galaxy; and partly to use it as a guide to a little pair lying a short distance *p*, and not so much *n*, being the nearest considerable star on that side in the finder. It is—

147. 257 P. XIX. *Aquilæ*. 4″. 276°·5. 8 and 10. White and smalt blue. A delicate object, and somewhat difficult for ordinary telescopes. Secchi considers it decidedly optical. A little *n* is a pretty group of four stars, the brightest of which is 253 P. XIX., 8 mag.

About 1½° *p Al Tair*, a little *s*, is a 7-mag. star, 252 P. XIX; a little further *p*, and rather more *s*, is—

148. 241 P. XIX. *Aquilæ*. 26″·8. 253°·7. 7½ and 9¼. Pale topaz and lilac. I remarked another smaller and more distant *comes*, and the field with a low power is rich in minute points.

Our diagram will enable us, at a future opportunity, to refer to some other objects worthy of notice in this region; at present we shall only indicate one, which is not included in it, and which is rapidly departing towards the sun—

149. 15 *Aquilæ*. 34″·5. 206°·6. 6 and 7½. Yellowish white and red lilac. This very fine optical pair may be

readily met with from the directions given in our last No., p. 142, for finding Knott's Crimson Star.

OCCULTATIONS.

Oct. 4th, B. A. C. 221, 6 mag., 9h. 23m. to 10h. 29m.—9th, 130 *Tauri*, 6 mag., 8h. 46m. to 9h. 30m.

PRECIOUS STONES.*

Objects that possess remarkable beauty, and are at the same time rare, are most likely to be sought after and prized in wealthy communities, and hence the various kinds of minerals called "precious stones" have stood in high favour amongst civilized nations in ancient and modern times. A certain class of philosophers have endeavoured to ridicule the taste, and the same theorizers on social morals have denounced all ornamentation in apparel or domestic implements as a mere matter of vanity and ostentation. Sir Thomas More tells us that his Utopians "find pearls on their coasts, and diamonds and carbuncles on their rocks: they do not look after them, but, if they find any by chance, they polish them and therewith adorn their children, who are delighted with and glory in them during their childhood; but when they grow to years, and see that none but children use such baubles, they of their own accord, without being bid by their parents, lay them aside, and would be as much ashamed to use them afterwards as children amongst us, when they come to years, are of their nuts, puppets, and other toys." A great many things in *Utopia* evince a mind far in advance of the age, but in matters of clothing and decoration we should decline to accept the teaching of its learned author, who represents his model people as wearing garments made of skins and leather, and making them last seven years. "When they appear in public," he adds, "they put on an upper garment which *hides* the other." These Utopians "wonder how any man should be so much taken with the glaring, doubtful lustre of a jewel or a stone, that can look up to a star or to the sun itself." The argument thus put, obviously breaks down, and we are entitled to ask how any man who loves the brilliant effects of light in one class of natural objects can fail to admire them in another? and we should doubt any one's appreciating the lustre of a star or the variegated hues of the rainbow who told us that

* *Diamonds and Precious Stones:* their History, Value, and Distinguishing Characteristics, with Simple Tests for their Identification. By Harry Emanuel, F.R.G.S. John Camden Hotten.

he saw no beauty in the rich rays emanating from the ruby or the prismatic colours flashing from the diamond. Light is a thing of surpassing beauty, and any apparatus capable of displaying its gorgeous effects will charm the thoughtful and poetic mind, whether it comes from the workshop of the jeweller or that of the optician.

Rarity, beauty, and durability are the characteristics of precious stones, and from their extreme hardness the art of cutting and polishing them demands a very high degree of manipulative skill. Fashion, of course, rules the average taste in these matters, and amongst those crystallized antiquities the Chinese, stones, such as the jade, thought little of in Europe, are valued at an enormous rate. Those who saw the collection exhibited a little while ago at the Crystal Palace could not fail to have their opinion improved of the beauty of this material; and if a lifetime is spent in elaborately shaping and carving it, the work of art thus created may be handed down to distant generations uninjured by the lapse of time. We do not know what special incidents in Chinese history led their emperors and wealthy men to set such store by jade; but fine pieces are rare, and the mode of working them costly, and thus, in addition to the beauty of the article produced, two other qualities combine to magnify its worth.

With reference to the class of articles comprised in the European jeweller's list of precious stones, beauty, rarity, and durability are their general characteristics; but superstition in some ages, and fashion in all, have had their share in deciding the conventional value in which they have been held. A cut diamond or ruby represents a large quantity of human labour, which would cease to be exerted in such a direction unless it met with an average recompense in the shape of profit and price. The amount of this recompense of course depends upon the relative proportion of demand and supply, and we now find some gems much dearer than in former times, and others cheaper, as fashion has decreed the extent to which the wealthy should seek for them. That portion of the value of precious stones which depended upon superstition and errors of science may be left out of calculation in modern Europe, as no one now pays an extra price for an agate, in order that by wearing it his mind may be disposed to solitude, or for an amethyst to keep him sober, or for an onyx to preserve him from epileptic fits. Neither do modern criminals, amongst the wealthier classes, buy diamonds in order to reduce them to fine powder and poison enemies or rivals by mixing this material with their food. Magical qualities were ascribed by the Cabbalists and their followers to the mystical breastplate of the Jews, and even in recent times attempts

have been made to revive superstitions of an analogous kind, but without sufficient success to affect questions of price.

With reference to many of the old stories, we wonder that erroneous belief was not exploded by experiment or observation; but popular credulity has usually been determined by authority or association, and at the present day very few persons are in the habit of rigidly testing the theories they are induced to accept. In Cellini's time the art of poisoning was carried to a diabolical perfection, but faith was not exclusively put in preparations really competent to produce a lethal result; he himself tells us that he narrowly escaped being poisoned by a pounded diamond, through a needy jeweller having luckily substituted some other stone. He argued that the diamond preserved its angularity in the finest powder, which was not the case with less hard substances, and he took it for granted that the sharp particles of the diamond caused it to stick in the coats of the stomach and thus produce an injury of which the victim died. Such reasoning as this, without experimental verification, would satisfy many persons now, and it has a plausibility about it much greater than was usually needed to satisfy the ancient or mediæval mind.

The superstitions connected with precious stones would form an interesting chapter in the mental history of mankind, and in tracing them we should find fancies that were elegant, as well as opinions that were absurd. We may if we please retain the poetry without hostility to science, and let our jewels symbolize the good qualities they were said to confer.

The chemical composition of precious stones is pretty accurately known; but the mode in which nature produces them is not understood. A destructive analysis, or one which resolves any compound into so-called elements, or substances that have hitherto resisted decomposition, gives no clue to the manner in which it can be *re*-formed. In some simple cases it is sufficient to bring the elements together, as when a metal like potassium and gas like oxygen form a binary compound if simply left in contact for a short space of time. In a great variety of cases, particular compounds can only be produced by indirect methods, and by causing bodies to act upon one another in what is called their *nascent* state, that is to say, in the condition of activity exhibited at the very moment in which they are separated from a previous combination, or in which they themselves are primarily formed.

To make precious stones by artificial means we must combine their elements as nature has done, or, as in the case of the diamond, arrange their particles in the precise form.

We know carbon in the dense opaque condition of charcoal, in the transparent gaseous state of carbonic acid, and in

the solid crystalline state in which the diamond is found. Liquids, such as ether, alcohol, etc., show us this same substance (in combination) in another physical condition; but we do not know how to make a solution of carbon in any fluid that will deposit it on evaporation in a crystalline pattern, nor can we fuse carbon like sulphur, and obtain our crystals as it cools. Carbon is pre-eminently a vegetable material, and plants as they grow collect it from the air, and assimilate it in their tissues. United with oxygen and lime, or magnesia, carbon also abounds in terrestrial rocks; but it is remarkable that animals low in the scale of organization, like the coral polyp or the rhizopod, are the great agents in building up strata of this kind. How nature deals with carbon in the production of the diamond is imperfectly guessed, not known. This work may be slow, so that ages may elapse before one of the precious crystals may be completed, or it may, under appropriate circumstances, be rapid, though apparently seldom performed. It may be due entirely to chemical and electrical agencies, or, as many suppose, the organic life of the plant may in some way be concerned in the formation of the gem. However it is produced, it is the hardest substance known. Mr. Emanuel says "it is found both in regular crystalline forms and in an amorphous state. The crystals are principally octohedrons or dodecahedrons, the planes of which have frequently the peculiarity of being either concave or convex; sometimes they are worn, by attrition or other causes, into heterogeneous forms, being nearly round balls, occasionally transparent, or covered with a thick crust." Its specific gravity is about three and a half times that of water, and its beauty is due to its optical properties. It refracts light very powerfully, reflects it from its inner surfaces very perfectly, and disperses or spreads the ray so as to exhibit the rainbow colours in a very splendid way. Mr. Emanuel gives the following comparison between the diamond and glass:—

THE DIAMOND.

Refraction	2·487
Dispersion	0·38

GLASS.

Refraction	1·525
Dispersion	0·32

From these properties arises the beautiful effect of a diamond receiving light from one direction, and pouring forth its coloured rays in another direction, where the radiance may look all the brighter through contrast with surrounding shade.

If diamonds were large, cheap, and perfectly homogeneous,

they would be valuable for the purposes of the optician; but as they do not comply with these conditions, the glassmakers have been applied to, and they have made glass of very high specific gravity, and much more refractive than in ordinary kinds.

The diamond is usually spoken of as infusible, but this is open to doubt. Professor Miller says, "When the diamond is introduced into the flame of the voltaic arc it undergoes a remarkable change; as soon as it becomes white hot it begins to swell up, loses its transparency, suddenly acquires the power of conducting electricity, becomes specifically lighter, and is converted into a black opaque mass resembling coke." The swelling up looks very much like incipient fusion, and in an experiment made by Mr. Gassiot with a very powerful Grove's battery, the appearance of fusion was greater than had been previously noticed; and when the action of the battery was arrested, the change into "a substance resembling coke" had not taken place.

Mr. Emanuel follows the common practice of speaking of the diamond as *pure* carbon. Professor Miller, however, states that it is not so, and that when burnt "it always leaves a minute yellowish ash, which has been found to contain silica and oxide of iron."*

The practical use of the diamond in cutting glass is well known. For this purpose a particular angle is required, and diamonds possessing it are called "glaziers." It is astonishing what wonderful fine writing points can be obtained. Mr. Farrants tells us that with such a diamond point and Mr. Peters' machine the Lord's Prayer has been legibly written in the three hundred and fifty-sixth thousandth part of an inch. In this specimen the writing is so small, that in similar characters the Bible and Testament, said to contain 3,566,480 letters, could be written twenty-two times in the space of an English square inch. With a diamond Mr. Norbert rules his amazing lines on glass, putting them at the rate of seventy in one thousandth of an inch in the closest of his bands. Those who have not an opportunity of seeing one of Mr. Norbert's ruled glasses, should look at Mr. Richard Beck's† admirable plate, representing their appearance when magnified thirteen hundred times. Under this power the closest lines were almost in contact.

Another practical use of the diamond is the employment of it in a powdered state, to cut stones too hard for any other material to operate upon. The diamond dust forms teeth in the rim of a steel wheel used in these processes.

The art of cutting the diamond in regular facets was not

* *Elements of Chemistry*, vol. ii., p. 61, second edition.
† *Beck on the Microscope*. Van Voorst.

known to the ancients; it is ascribed to Louis von Berghem in 1456. The Dutch are now the great diamond cutters for the world, the chief establishments being at Amsterdam, where the largest mills, those of Mr. Coster, employ, as Mr. Emanuel tells us, five hundred to six hundred workmen. "To this firm was entrusted the cutting of the Koh-i-noor."

Mr. Emanuel observes, "the general form of the rough diamond is of two pyramids joined at the base: if a diamond is not naturally of this form, it must be made so by art." To cut diamonds, two stones are fixed with cement to the top of two sticks, and they are rubbed together till a facet is produced. "It must be understood that by this operation only the general outline of the form is made. A stone which would have, when quite completed, fifty-eight facets, including the table and culet, receives in cutting only eighteen, eight of which are the surfaces of an octohedron, or double pyramid, and are formed by taking away eight edges or angles of these eight surfaces, one for the whole table and one for the culet." The "table" is the flat face at the top of a brilliant; the "culet" is the small face terminating the pyramid into which the back of the brilliant is worked. In the rose form of cutting there is no "table." The "diamond polishing" on a steel disc, with diamond powder, gives the remaining facets required for the perfect form, and leaves the surface brilliantly smooth.

In Mr. Emanuel's book will be found a series of diagrams representing the different patterns into which diamonds are cut, and he also gives views of the most famous diamonds in the world.

In the case of the diamond we have an instance of a very common material having its particles so arranged as to confer upon it very remarkable properties not exhibited by the same substance in other conditions. The ruby, the sapphire, the oriental topaz, the *oriental* emerald, and some other gems, are composed of a material as common as carbon—namely, *alumina*, the earthy oxide of aluminium, a metal now in frequent use, and the basis of all kinds of clay. In *Dana's Mineralogy* these gems are treated as minerals composed of uncombined alumina, but this is not absolutely true. Mr. Emanuel gives an analysis of a ruby, or red sapphire, which represents it as containing—

Alumina	98·5
Oxide of Iron	1·
Lime	.5
	100·

And it is probable that these minute quantities of extraneous

matter influence the mode in which the molecules of alumina are aggregated and the gem produced. Sapphires come next in hardness to diamonds, and rubies of large size, and of the "pigeon's blood" colour, are so rare as to command prices higher than those of diamonds. The *oriental* emerald, or green sapphire, is, as Mr. Emanuel informs us, "the rarest of all gems, and is scarcely ever seen." Even so large a dealer in these commodities as Mr. Emanuel "has only met with one specimen in the whole course of his experience."

The foolish whims of fashion in respect to gems seem to be displayed against the yellow sapphire, or oriental topaz. It is a jewel of remarkable beauty, and yet stated to be of very little value in commerce. Those who like gems for their beauty more than for their rarity, should take advantage of these freaks of fashion, and buy those things that have substantial merit when their commercial price is low. Yellow quartz is often called topaz, but it is a very inferior thing to the oriental gem. There are also Brazilian and Saxon topazes, which are fluorides of silica and alumina.

Thus far we have seen the two most valuable gems, diamonds and rubies, to be composed of very common materials in an uncommon condition. The opal may be added to this list, being a compound of silica, or flint, with a little water, and minute portions of iron, alumina, etc. The emerald—*not* the *oriental* one, or green sapphire—mingles with the common materials, silica and alumina, about 13 per cent. of glucina, a rare earth. Glucinum, of which glucina is an oxide, is a white malleable metal, which few chemists have seen. It fuses below the melting point of silica, and does not burn in air or oxygen. The name *glucinum* was given from the Greek, γλυκύς, sweet, in allusion to the taste of its salts.

Beryls and emeralds only differ slightly in composition. The finest emeralds come from New Granada, where they occur in a limestone rock. The colour of the emerald was supposed to depend upon its containing a small quantity of oxide of chromium, but Mr. Emanuel inclines to the opinion of Mr. Lewy, who ascribes it to the presence of a vegetable matter analogous to the chlorophyll of plants.

The zircon, hyacinth, or jacynth affords, like the emerald, a specimen of a gem containing a rare substance mixed with others that are common—the composition showing nearly 67 per cent. of zirconia, and the rest silica with a trace of iron. Zirconia is the oxyde of zircon, a metal about which nothing interesting is known. The jacynth is formed of various colours, from red to grey and white. The ordinary specimens look like a tawny emerald, and have little beauty, but fine ones may merit the favour which poets have sometimes bestowed

upon this gem. Tennyson speaks of the hilt of Arthur's famous sword, "Excalibur," as twinkling

> "With diamond studs,
> Myriads of topaz lights, and *jacynth* work
> Of subtlest jewellery."

And perhaps some jacynths might be worthy of such a place.

Garnets are silicates of alumina, iron, lime, magnesia, etc. In India, at Delhi, and in Bohemia they are marvellously cheap, but after paying half-a-dozen profits, they are not inexpensive articles to purchase at retail shops. The carbuncle is a garnet cut with the rounded "cabouchon" form, and when fine, gives much beauty for a moderate price.

To silica, one of the commonest minerals of the globe, we owe, in addition to the opal already spoken of, a host of gems of more or less beauty and value, such as the amethyst, the cairngorm, the chrysoprase, the onyx, the sardonyx, the carnelian, agate, cat's-eye, jasper, bloodstone, etc. Quartz gems are usually of little value, though, as Mr. Emanuel states, "a solitary specimen of fine quality may bring a large price."

The turquoise is a phosphate of alumina, with a little iron, copper, etc. The best come from Persia, but the fossil bone turquoise, or odontolite, comes from Languedoc, and may deceive the unwary, though it is softer, of a different texture, and of much lower price.

The felspar minerals are essentially silicates of alumina and potash, and they give us one gem which, when fine, is of remarkable beauty, and strangely neglected by jewellers, and by the public—we mean the moonstone, the best of which comes from Ceylon. It should be clear as glass, hard enough to scratch glass easily, and also to scratch quartz; in certain directions its curious internal structure should give brilliant flashes of light of an exquisite *mooney* tint. A lady of our acquaintance recently became possessed of four fine specimens of this stone, which she had simply mounted in a star-shaped brooch, with four carbuncles and a small opal in the centre. The effect was remarkably good, and we recommend those curious in such matters to look out for choice moonstones while fashion is blind enough to let them go cheap.

Mr. Emanuel deserves a good word from us before we conclude. His work on gems is a very elegant production, supplying just the sort of information that purchasers and possessors of jewellery will like to have. It gives an account of all the most interesting of the precious stones; describes their quality and composition; the modes of cutting them, etc., etc. It is illustrated with many plates and diagrams, and is a handsome book for the drawing-room or the boudoir.

COMETS.

AN ACCOUNT OF ALL THE COMETS WHOSE ORBITS HAVE NOT BEEN CALCULATED.

BY G. F. CHAMBERS.

(*Continued from Page* 126, *Vol.* viii.)

1402. About February 8, a comet appeared, which afterwards became very brilliant, so much so as to be visible in the daytime; it lasted till the middle of April. It appears to have been first seen in the S.W., setting in the W. At the beginning of March it was in Aries, and was seen from two and a half hours before, till three hours after sunset, or even later. Subsequently it was seen in the N.W. on Palm Sunday, March 19; its size was prodigious.—(Walsingham; Poggius, *Historia Florentina;* Ebendorfferus, *Chronicon Austriacum.*)

1402. [ii.] From June to September, an immense comet was visible in the W.—(Ducas, *Historia Byzantina.*) The descriptions are long, but contain nothing of practical value. The comet was visible in the daytime, and perhaps it attained its maximum brilliancy at the end of August. This, or the preceding, was regarded as the sign, by some even the cause, of the death of John Galeas Visconti Duke of Milan.—(*Annales Forolivienses.*)

1406. Some time between January and June, a comet appeared in the W. for several nights.—(*Chronicon Bremensis.*)

1407. On December 15, a comet was seen.—(Biot.)

1408. On October 16, a comet, or something like one, was seen.—(Antonius Petrus, *Diarium Romanum.*)

1429 or 1430 (preferably the latter). A terrible comet appeared on August 24.—(Kaempfer, *Historie du Japon,* ii. 5.) Gaubil mentions a great star having been seen for a week in October, November.

1431. On May 15 or 27, a comet 5° long was observed in the feet of Gemini.—(Ma-tuoan-lin.)

1432. On February 2, a comet about 10° long appeared. It "swept" the region near *a* Cygni, and disappeared on February 12. On February 29, another comet (doubtless the same, after its P. P.) became visible for seventeen days.— (Biot.)

1436. James I. of Scotland was assassinated on February 20, 1437. During the previous autumn a comet was seen.—(Boethius, *Hist. Scot.* xvii.)

1439. [i.] On March 25, a comet was seen. It traversed Hydra, Leo, and Cancer. On April 2 it had a tail 5° long.—(Biot.)

1439. [ii.] On July 12, a comet about 10° long appeared near the Hyades for seven weeks.—(Biot.) Perhaps the preceding after its P.P. A comet, lasting one month, was seen this year in Poland.—(Duglossus *Historia Polonica*, xii.) In Japan also a comet was seen.—(Kaempfer, *Hist. Japon*, ii. 5.)

1444. A comet appeared about the time of the sun's solstice, or on June 15 according to others.—(G. Fabricius, *Rerum Memorabilium Germaniæ*.) On August 6, a comet 10° long was seen to the E. of Leo; it became longer day by day, till August 15, when it entered the sidereal division of *a* Virginis and disappeared.—(Biot.)

1452. On March 5, a comet appeared near the Hyades.—(Gaubil.)

1453. On January 4, an extraordinary star appeared near the nebula in Cancer (Præsepe). It went slowly westwards.—(Biot; Gaubil.)

1454. In the summer, a comet like a sword became visible in the evenings after sunset.—(Phranza, *Chronicon De Rebus Constantinopolitanis*, iii.)

1457. [i.] On January 14, a comet with a tail ½° long was seen in the division of ϵ Tauri. It went to the S.E., and on January 23 it disappeared.—(Biot; Pontanus, *Historia Gelrica*, ix.)

1457. [ii.] In June, a comet appeared in the 20th degree of Pisces.—(*Chronicon Nurembergense, etc.*) The conclusion seems unavoidable, that there were two comets in June, and that this is not identical with the one computed by Hind.

1458 or 1459. (Probably the former.) In June, July, a comet appeared in Taurus [?].—(De Mailla, x. 236; Rockenbackius, *Excerpta Cometarum*.)

1458. On December 24, a star appeared in the division of *a* Hydræ; it went to the W. till December 27, when it became faint; it was near α, γ, ζ, η Leonis. On December 31, it had a tail ½° long; it "attacked" λ (or ϕ) Cancri. On January 12, 1459, it disappeared in the division of μ Geminorum.—(Biot.)

1460. James II. of Scotland was killed on August 3, 1460. The evening before his death, a very brilliant comet with a long tail was seen.—(Boethius, *Hist. Scot.* xviii.)

1461. On July 30, a white star appeared near *k*, *l*, *g* Tauri Poniatowski. On August 2, it transformed itself into a vapour and disappeared.—(Biot.)

1463. In this year (no month assigned) a comet was seen near τ and υ Virginis.—(Gaubil.)

1464. In the spring, a comet was seen in Leo.—(Gaubil.)

1465. In March and April, a comet with a tail 30° long was seen in the N.W.—(Biot; Kaempfer, *Hist. Japon*, ii. 5.)

1467. In October, a comet was seen above Pisces, "as if it had been formed in Cancer." Rainy weather prevented its being often seen.—(*Chronicon S. Ægidii Brunswicensis.*)

1468. [i.] On February 24, a comet was seen near Ursa Major.—(Gaubil.)

1471. In autumn, a very great comet was seen in Poland. It was in the latter part of Virgo, and in Libra, and lasted a month.—(Michovia, *Chronica Polonorum*, iv. 62.)

1476. From December, 1476, to January 5, 1477, a small comet was visible.—(Ripamontius, *Historia Urbis Mediolanensis*, vi.)

1477. In December, a comet appeared.—(*Chronica Bossiana.*)

1478. In September, a great comet was seen.—(*Chron. Boss.*)

1491. On the Festival of the Epiphany (January 6), a comet was seen between the 20th and 30th degrees of Pisces. Its head was small, but its tail was long, though faint. It followed the sun after its setting, and the tail was turned towards the E. on January 17, between six and seven hours of the evening. Bernard Walther, at Nuremberg, observed the comet in Aries.—(Michovius, iv. 64; Regiomontanus, *Scripta Mathematici.*) In China, on January 13, according to Gaubil, a comet was seen *in* Cygnus. If this refers to the same object as was seen in Europe, it can only be understood as meaning that the comet reached to Cygnus.

1495. On January 7 a star was seen near θ, ρ Ophiuchi; it travelled with a slow motion till February 20, when it entered the division of α Aquarii.—(Biot.)

1502. On November 28, a star appeared near Pyxis Nautica. 'From the division of ν^1 Hydræ it directed itself towards that of α Crateris. On December 8, it disappeared.—(Biot.)

1503. At about the time of the Festival of the Assumption of the Virgin Mary, August, a comet was seen. Its tail pointed towards the E.—(*Chronicon Waldsassense.*)

1505. A comet was seen in Aries. It lasted only a few days.—(Mizaldi, *Cometographia.*)

1512. In March and April, a comet appeared.—(*Chronicon Magdeburgense.*)

1513. From December, 1513, to February 21, 1514, a comet was visible. It passed from the end of the sign Cancer to the end of that of Virgo, and was seen all night.—(Vicomercatus, *Commentarii, in lib Aristot. Meteor.*)

1516. The death of Ferdinand, the Catholic, King of Arragon (January 23), was announced by a comet which lasted many days.—(Bizarus, *Historia Genuensis*, xix.) Others say the comet was only visible for a few days.

PROGRESS OF INVENTION.

PRODUCTION OF FORMIC ACID FOR INDUSTRIAL PURPOSES.—The use of this important acid has been more or less limited hitherto, by the difficulty, and consequent cost, of its production. The mode of obtaining it devised by M. Lorin leaves nothing to be desired, either with regard to simplicity or cheapness. His process is founded on the power which glycerine possesses of producing formic acid by the decomposition of oxalic acid; but he applies the principle in such a way as to obtain directly formic acid of great strength. He heats a mixture of ordinary oxalic acid and anhydrous glycerine; reaction begins at 79° Cent., and attains a maximum at 90°; carbonic acid is disengaged, and an aqueous fluid charged with formic acid passes over. Adding a new quantity of oxalic acid to the glycerine, some time after the evolution of carbonic acid has ceased, causes decomposition to recommence, and a fluid still richer in formic acid passes over. Successive additions of oxalic acid to the glycerine at length causes the formic acid in the receiver to be of the strength required for crystallization. The process is very simple; and as the evolution of carbonic acid marks its phases sufficiently, it is unnecessary to pay any attention to the temperature. The same glycerine might be used for the production of any amount of the acid, except that the impurities always found in the oxalic acid would lead to waste. The same glycerine has, however, been used continuously night and day for months. The process just described affords a product containing 56 per cent. formic acid; if anhydrous oxalic acid is used, the product will contain 75 per cent. acid. Decomposition will commence at 50° Cent.; and care must be taken to apply the heat cautiously, so as to prevent an inconvenient swelling up of the mass. Monohydrated crystallizable formic acid may be obtained by acting on formic acid of 70 per cent., at an elevated temperature, with anhydrous oxalic acid, and distilling. It crystallizes when the temperature is lowered sufficiently.

FORMIC ETHER.—The process just described supplies a means of producing formic ether, a fluid having a remarkably agreeable odour, with great economy. Oxalic acid and alcohol, in nearly equivalent proportions, corresponding to the ether required, are added, at the same time, to saturated glycerine, and submitted to the proper temperature. The formic acid, according as it is produced, combines in the nascent state with the alcohol. The condensed vapours are to be returned to the retort when the decomposition of the oxalic acid is complete, and the ether is to be distilled over: it may be purified in the usual manner.

SILK PRODUCIBLE IN THESE COUNTRIES.—Hitherto the economic production of silk has been confined to hot countries; the Acclimatization Society of Paris has, however, recently introduced a silkworm (*Bombyx Cynthia*) which will thrive well even in northern climates, being unaffected by rain, wind, or frost; the only effect, indeed, produced by the genial nature of the climate being the more

rapid production of the cocoon. This promises to open a new and profitable branch of industry for Ireland and other portions of the British dominions. The Ailanthus, upon the leaves of which the silkworm feeds, thrives well in this country, and has already been introduced largely into France. It grows rapidly, and its wood is of the very best description for any industrial purpose. The young worms require to be kept in the house for a few days after having been hatched; and at every period of their existence they require moisture. The silk, though an excellent textile material, is not equal to that obtained from hot countries; and some difficulty has been experienced with the process of winding it, since, as the cocoon is open at one end, it will not float in water; and, having no gumming matter, it affords only spun silk. It is, however, easily bleached, and it takes dyes extremely well.

Substitutes for Ivory, etc.—An excellent substitute for ivory, bone, horn, etc., may be obtained by cutting caoutchouc or gutta-percha into small pieces, after it has been thoroughly washed, and then dissolving it in well-closed vessels with chloroform, or some other solvent. When the solution is complete, chlorine is passed into it, until the whole assumes a bright yellow tint: after which the product is to be washed well with alcohol. It is then to be augmented in bulk by means of a small quantity of chloroform and agitating; and chalk, oyster shell, marble, heavy spar, allumina, or sulphate of lead, in the state of fine powder, is to be added, to an amount dependent on the density and tint which are required. Having been kneaded, the mass is to be formed into blocks of a size suited to the purpose for which they are intended, and subjected to pressure. The result answers well for buttons, knife-handles, etc., and may be cut, turned, and polished in the same way as ivory.

Catalytic Action of Potatoe-peel, etc.—Schönbein has recently discovered that catalytic power is not confined to diastase, gluten, saliva, and a few other organic substances, but is very generally diffused through the animal and vegetable kingdoms, and is possessed in a very remarkable degree by potatoe-peel, lettuce, the root of dandelion, etc. So effective is potatoe-peel, that if kept for ten or twelve hours with starch, at a temperature of from 45° to 50° Cent., the starch will all be changed into sugar.

New Method of Removing Hair from Hides.—The ordinary method of removing hair from hides is tedious and troublesome, and leads to considerable loss from abrasions of the hide. These inconveniences have been obviated by a process which has been recently invented. The hides are placed in a close chamber, in which water is violently scattered about, so as to be brought into such a state of minute division, and form a species of vapour, which, no mode of escape being afforded to it, enters into the pores of the hides. In a few days they become so soft, that the hair may be removed so easily that three times as many skins may be deprived of it in a given time, as by the usual method, and without the smallest tendency to putrefaction, or injury to the skins. The rapidity of the process depends on the minute division of the watery particles, the closeness with which they are brought into contact with the

hides, and the completeness with which the air is excluded. As hides prepared in this way require somewhat more bark in tanning, the leather they afford is of a very superior quality.

Oxidation of Fat Oils by the Action of the Atmosphere.—It has long been known that fat vegetable oils, when exposed to the air, thicken, and become more or less hard, by absorbing oxygen; the amount and rapidity of the effect produced on them being greatly modified by the temperature, and the degree of exposure to light. M. Clöez, having made numerous experiments on the precise effects of heat and light, has added considerably to the very large amount of knowledge we have obtained regarding these oils from the researches of Chevreul and other able and indefatigable investigators. M. Clöez examined four kinds of oil—two non-siccative and two siccative; the former being sesame and castor oils, and the latter poppy and linseed oils. He endeavoured, by every possible precaution, to render the conditions of the different experiments exactly similar, so that perfectly reliable comparisons might be made. The exposure to air, in every case, continued for 150 days; in some of the experiments white, in others coloured light was admitted to the oil, in others light was entirely excluded; and the augmentation of weight was noted at different intervals. It was found that for thirty days the oil exposed in white glass increased rapidly in weight; that it increased nearly to the same extent in blue glass; very little in red or green glass; and not at all in darkness. After thirty days the increase in weight was greater with blue than with white glass; and after a longer or shorter period the increase was greater with red and green, than with white and blue glass. After some time, the rapidity with which the weight augments becomes greater: after 120 days the augmentation with poppy oil was found to be about double what it had been after 60 days; but after 160 days it was more than trebled. Heat greatly modifies the effects of exposure. When linseed oil was heated for six hours to 100° Cent. in a water-bath, in a current of atmospheric air, not only was the weight increased, but vapours of a suffocating odour were produced. It is an important fact connected with the art of painting, that the oxidation may be very much accelerated without the application of heat, by the addition of a small quantity of oil of the same kind, which has been previously thickened by exposure to the atmosphere. Oil for painting may therefore be prepared so as to be perfectly colourless, and consequently to produce no diminution of the brilliancy of the colours.

Illuminating Gas from Vegetable Refuse.—The utilization of the refuse left after the making of cyder and perry is now being very successfully effected in France. It had been hitherto good for nothing, and in some cases was a source of actual inconvenience and loss. The same thing is more or less true of the waste left from the apples and pears after making cyder and perry in these countries. This otherwise worthless material is now employed in the manufacture of an illuminating gas of most excellent quality, its light-giving power being of a high order, and its combustion not in the least injurious to painting or gilding, since it contains no

sulphur or other mischievous ingredient. The apparatus required for its production is of the very simplest kind, consisting merely of a furnace, a still head, and a contrivance which serves both to wash and purify the gas, and to retain it until required for use. It is evolved at a temperature very far below that required for the destructive distillation of coal, resin, etc., and therefore the cost of fuel is insignificant, and the wear and tear of the apparatus next to nothing. A ton of the refuse matter yields about seventy cubic metres of gas.

Novel Application of Electricity.—It is undoubtedly a matter of considerable importance in many harbours that it should be known with certainty by those about to enter or leave, when there is a sufficient depth of water for the purpose. M. Emile Duchemin has devised a very simple application of electricity, which answers admirably for this purpose. He attaches to a small float a plate of carbon and a plate of zinc, and connects these respectively with the wires of an electric bell-ringing apparatus. Throwing the float and battery into the sea will cause the bell to ring. When therefore they are suspended at any required height, within reach of the tide, as soon as the water has risen sufficiently to set the small battery in action, the bell will ring; and thus the apparatus may, at pleasure, be made to indicate any state of the tide. By using a sufficiently large float and battery, it is evident that an electric current will be generated sufficient to sound a bell of considerable size, or, by means of Geissler's tube, to produce a light which will be seen from a great distance.

A simple Method of producing Ice on a Large Scale.—Refrigeration is now used extensively for industrial and other purposes. Solid matters dissolved in fluids are thoroughly separated from them by freezing; and the principle has been applied with great success to the obtaining of the sugar from syrup, etc. A simple and economic method of producing a freezing temperature is therefore of considerable importance. A new method of effecting this has recently been tried in Paris, with very successful results. It depends on the circulation of ether; but unlike the other processes in which this is used, it requires no pump. The amylic ether which is employed is obtained and purified in the usual way. Its vapour is transmitted at a pressure of from five to seven atmospheres into a vessel, in which it becomes liquified. When a cock is opened for the purpose, it passes from this vessel into spiral ducts which surround the reservoir filled with the water, etc., which is to be frozen, and immersed in a solution of salt, which is not frozen even by a very low temperature. After having been vaporized in the spirals, the ether vapour passes into three large cylinders containing sulphuric acid, by which it is absorbed. A portion of the ether is always ready to be driven from the saturated solution containing it, by means of the heat which is supplied by superheated steam, into the vessel in which it is again liquified, preparatory to its being again used for the production of cold by evaporation. A machine calculated to form in this way 200 kilogrammes of ice in an hour has been constructed for the separation of the salts contained in sea-water.

Stebbometal.—This important alloy possesses some valuable properties which make it well deserving of attention. It may, in many cases, be substituted for bronze, iron, or steel, with great advantage: and is likely to prove valuable to the makers of various kinds of instruments and machinery. It is formed by fusing together from 55 to 57 per cent. copper, from 40 to 42 per cent. zinc, 1·8 per cent. iron, and from 0·15 to 0·8 per cent. tin. The colour of this compound is very similar to that of gold. The cast metal is rendered malleable and ductile by hammering or pressure, at a red heat—a higher heat would produce brittleness, and a lower would injure the texture. The tenacity of the cast metal is equal to the support of 42·29 kilogrammes the square millimetre; of the malleable, to the support of 53·99 kilos.; and of the ductile, to the support of 59·72 kilos. It takes a fine polish.

Black Phosphorus.—Hitherto we have been accustomed to consider white as the colour of perfectly pure phosphorus, or red when the phosphorus is in the amorphous state. There is now, however, good reason to believe that its normal colour is black. Long ago, Thenard obtained black phosphorus; but the process he used was more or less uncertain, and it was never repeated with success by other chemists. M. Blondlot has, however, discovered an infallible process for obtaining black phosphorus. He purifies phosphorus of the ordinary kind by repeated distillations, in a sand-bath and in a current of hydrogen; the yellow or impure portion, which is volatile—and therefore not separable by distillation—being changed into red amorphous phosphorus, which is fixed, by exposure for several days to insolation, previous to each repetition of the process of distillation, and the product being received into distilled water, kept at 90° Cent. When the phosphorus is become thoroughly pure, if slowly cooled, it will on falling to 42° be a white mass, which, when 8° or 10° are reached, suddenly changes to black. Black phosphorus becomes colourless again by fusion, but recovers its blackness if slowly—and sometimes if suddenly—cooled. It is like common phosphorus, except that it is more stable, softer, and more flexible. It becomes coated with white, in water; and with red, in the atmosphere: but a single distillation renders it, in each case, again black. Very old phosphorus—it is supposed by some kind of spontaneous purification, depending on a change in its molecular condition—is very often changed to black throughout its whole mass, except the outside, which is red.

Miscellaneous.—*Alloys of Manganese.*—An alloy consisting either of two atoms of manganese and one of iron, or of four of manganese and one of iron, is harder than the hardest steel, is of a colour between that of steel and silver, and is capable of receiving a high polish. It fuses easily, and is not oxidizable by the atmosphere. It may be formed by keeping a mixture consisting of oxide of manganese, powdered charcoal, and cast or wrought iron in a state of tolerably minute division, at a white heat, for some time in a graphite crucible; the whole having been covered up in the crucible by a layer of common salt, or of some other substance

suitable for excluding the air. A compound possessing the good qualities of iron, and not acted on by the atmosphere, is likely to prove invaluable. Alloys of copper and manganese may be obtained in a similar way, and some of them possess very important properties.——*Generation of Heat by Friction.*—This is a subject which is exciting some interest in France at present; and although, generally speaking, the production of motion by means of heat, and the change of this motion back again into heat, is too circuitous a mode of proceeding to be economical, there may be circumstances in which it would be preferable to any of the ordinary methods of obtaining heat. M. Pelon's contrivance for the purpose consists of a truncated cone of wood, covered with hemp, and revolving within a similar cone of copper, in such a way that considerable friction arises from the rubbing of the hemp against the copper, while at the same time this friction is prevented from becoming inconveniently great by a lubrication which is effected by an ingenious application of centrifugal force. The whole is placed in a metallic casing, within which the air to be heated is made to circulate slowly. A large apartment is said to have been effectively and very rapidly warmed by this apparatus with a trifling expenditure of force; and it seems applicable to the heating of railway and other carriages, the cone of wood being kept in motion by the revolution of the carriage wheels.——*Evaporation by Mechanical Means.*—The evaporation of solutions for the production of crystals, etc., constitutes a serious item of expense. It is found that this may be greatly lessened by a concentration or preparatory evaporation effected by mechanical means. For this purpose horizontal cylinders are placed, one at the top and the other at the bottom of a frame, the lower cylinder being immersed in the liquid to be evaporated. Over these cylinders are stretched a number of vulcanized India rubber cords; and when the upper roller is turned by the hand, or by other suitable means, these ascend, carrying up with them portions of the fluid, and bringing them into contact with the air, which—especially under exposure to the sun—causes large quantities of moisture to be dissipated. The effect thus produced is found much cheaper than when obtained by the agency of heat in the usual way. ——*Artificial Leather.*—This is now formed by mixing cuttings of leather with an equal bulk of solution of caoutchouc, spreading the mixture, to a desired thickness, on plates of metal, and when the outer surface has become sufficiently hard, passing the whole between rollers, then drying at 90° Fahr. The artificial product thus obtained may be pressed into any desired shape in moulds, and used for any of the purposes to which leather is applied; it may even be vulcanized, by a very simple process.——*Cocaine.*—This substance, which is not long discovered, is one of that class to which theine, caffeine, etc., belong. It is obtained from coca, the leaves of the *Erythroxylon coca*, a South American shrub, which are chewed very generally by the inhabitants of those regions where it grows, and is remarkable, not only for enabling persons to endure the want of food, but for being in a surprising

degree a substitute for it. If introduced into these countries, it might, to some extent, supersede tobacco, and advantageously; but its flavour, though not actually disagreeable, is such that it never can come into very common use. Its consumption is another instance of that extraordinary instinct which has led the different portions of the human race to agree in selecting, without knowing it, some one source or another of a highly nitrogenized, and, for some reason not yet certainly known, most important compound. ——*Incompressibility of Water.*—Baron Séguier has discovered that if a glass cylinder is plunged vertically into a vessel of water, in such a way that some of it will be in, and some above the water, and a ball of lead is allowed to fall within it, along its axis, the glass will be cut horizontally on a level with the surface of the water, the part above being quite uninjured, and the part below being broken in pieces longitudinally. The effect is due to the incompressibility of the water, of which it is a curious illustration. Similar phenomena, on a large scale, have been well known for some time. A cannon exploded under water produces the most violent effects on subaqueous constructions which are near it; and rocks are now blasted under water by exploding gunpowder near them, instead of within cavities formed in them.——*New Mode of Preparing Grains.*—The ordinary method of removing the outer coating of grain is attended with great waste of valuable constituents of the corn. A very favourable official report has been lately made on the means used by M. Poissant for avoiding this evil. His apparatus consists of a hopper, which conduct the grain into a cylinder, where it is subjected for some minutes to a beater, which makes nearly four hundred revolutions a minute. The pellicle is thoroughly separated in this way, and is removed by a current of air, and along with it dust, and matters due to cryptogamic vegetation; and after which it is ground—only the one thirty-first of the total weight being lost during the process. The bread made from the flour is not, perhaps, so white, but it is more wholesome than with grain treated in the ordinary manner.——*New Break.*—Every one must have remarked that when a carriage is descending a hill, the front of the pole is thrown up by the efforts of the horses. This fact has been applied to the construction of a very powerful break, which derives its force from this movement of the pole. And, therefore, it is effective, in proportion to the efforts of the horses—that is, to the necessity for it. At the same time it is under perfect control.

ARCHÆOLOGIA.

At the recent meeting of the British Archæological Association at Durham, under the presidency of the Duke of Cleveland, the Rev. Prebendary Scarth, of Bathwick, Bath, communicated a discovery he had recently made in Gainford Church, in the county of Durham,

of a ROMAN VOTIVE ALTAR, which had been used for material in building. It was dedicated to Jupiter Dolichenus. Several altars have been found in Britain dedicated to Jupiter under this name, which is said to have been derived from Doliché in Macedonia, where there were extensive iron mines. This makes about half a dozen Roman inscriptions to Jupiter Dolichene found in this island, and, as we understood Mr. Scarth, he considers that they generally mark the neighbourhood of iron mines worked by the Romans, as being placed under the protection of the god under this character. Perhaps, however, we ought to take this suggestion with some reserve. It was a common practice with the Legionaries to dedicate their altars individually to the deities who presided over the native country of each, and in all these cases the altar, or votive tablet, may have been offered by a soldier who came from the district of Doliché. The presence of mines in the localities where they are found is easily accounted for. We know that the Roman mines were worked by men generally of bad character, condemned criminals, degraded slaves, and others, whom it must have required an armed force to hold in check, and there were no doubt small military posts in their neighbourhood. It may be added, that the stone on which this inscription was cut has been somewhat mutilated and defaced, and that, although Mr. Scarth's explanation was perfectly satisfactory as far as it went, a part of it has not yet been fully deciphered.

The ROMAN REMAINS found on the brow of a cliff at FILEY in Yorkshire in 1857, and described in a brief paper by Dr. W. S. Cortis, were brought for exhibition at the meeting at Durham. They were numerous, and of a miscellaneous character, consisting of upwards of forty coins, in third brass, of the later emperors; of a quantity of bones and pottery, among which was one fine vessel of the Durobrivian ware; of oyster, limpet, and mussel shells; and of various other articles, among which were several legs of fighting cocks, showing that the well-known love of the Romans for cock-fighting had reached even this remote corner of the earth. Much charred wood was found scattered about, and other indications of burning, so that whatever building had stood on this spot, apparently a watch-tower or lighthouse, had perished in a conflagration. Five square bases of columns were found, arranged in a parallelogram, which measured seventeen feet by fourteen, one at each corner, and the fifth in the centre, which had evidently supported a superstructure. A smaller column, on the northern side, seemed to indicate the position of a doorway. Close to the eastern stone a bit of shale was found, which had broken off a larger piece, in the middle of the one side of which was drawn a large A, with scrawls which appeared to have no meaning. On the other were parts of two lines of an inscription, of which the following words remain:—

CÆSAR SE
QVAM· SPE

It has been written probably by some individual in mere playful-

ness, and has not been, as Dr. Cortis thought, an inscription of importance. He conjectures that Filey Bay was the Ενλιμενος Κολπος of Ptolemy, which Richard of Cirencester, merely translating Ptolemy's name, calls Portus Felix. The next promontory, now called Filey Brigg, is identified by Dr. Cortis with the *Brigantium extremum* of the same writer, the extreme southern point of the country of the Brigantes on this side, and the boundary between them and the Parisi; and he believes that the remains described above mark the site of the Prætorium of the Romans.

On the subject of our recent remarks on the use of the term FRITH-GEARD we have been favoured with some observations by our correspondent J. C., which hardly bear relation to what we had said. If our correspondent will turn again to our article he will see that our remarks applied to Anglo-Saxon words, and the practices of the Anglian population of Northumbria, and not to Cornish words or customs. However, his notes on the latter seem to us sufficiently interesting to deserve publication, and we give them gladly. He says:—

"At the present time, in Cornwall, there are numerous words in daily use which have their proper meaning in the more ancient language of our island, long before the Saxons found an entrance into it; to which also may be joined ordinary practices and opinions; and among the former these two words find a place, as does the thing also that is signified by the former of them. With us of the West a freith signifies the very opposite of a circle of stones, or of stones in any other manner of arrangement; and it can be only remotely connected with a circle of any sort. It refers, in the first instance, to the materials of which the erection is formed, and then to the manner in which they are intertwined together, while the object kept in view may be of several sorts; but easiness of formations constitutes an important particular. It is, in fact, a wattled work, made of interlaced twigs and branches of trees, supported by posts driven into the ground, and the whole forms a fence to prevent the passage of man or beast. It may serve the purpose of its erection for a considerable time, but of course is less substantial and enduring than a stone wall; but it has the advantage that, when repair is required, it is soon and easily accomplished by those who might find it difficult to repair a substantial wall, and it is also speedily removed when necessary. The geard, or, as it is now even sometimes expressed, a gaard, is only remotely a yard, but it always signifies a defence; and certainly there was a time when the word was applied to a castle, as well as to any inferior enclosure intended for protection. It is probably the root or parent of our modern terms, to guard and gird; and for some purposes a freith or wattled erection might be as effectual as if it were constructed of more solid materials.

T. W.

PROCEEDINGS OF LEARNED SOCIETIES.

BY W. B. TEGETMEIER.

THE BRITISH ASSOCIATION.

THE annual meeting of the British Association for the Advancement of Science has been held this year at Birmingham. Professor Phillips, in his inaugural address as president, gave an admirable *resumé* of the progress of science during the past year. Among the more valuable communications to the different sections, may be mentioned Professor Jukes' Lecture on the Possible Extent of the Coal Measures below the Red Rocks of the Midland Counties of England.

The continued prosperity of this country so greatly depends on the supply of mineral fuel, that the recent prognostications of certain eminent geologists as to the possibility of that supply being exhausted in less than a century, at the continuously accelerated rate of consumption, have given rise to much uneasiness.

Professor Jukes mentions that there are doubtless large tracts of coal measures containing good beds of workable coal under the Red Rocks of the Midland Counties, but that there are also many parts where the coal measures do not exist under these rocks. The Carboniferous Limestone or coal formation was formed in a sea which certainly spread over the greater part of the British Islands; but at the time of its existence, an island, or, perhaps, numerous islands, consisting of lower and previously-formed beds, stretched across the Midland Counties, from Wales through Shropshire, Staffordshire, and Warwickshire into Leicestershire, and, perhaps, extended still further south and east. In consequence of these islands existing in the sea, little or no carboniferous deposits took place in the districts named.

Subsequently, however, this land was depressed beneath the water in which the coal measures were formed, and the uppermost beds of that group spread in level sheets over the land. Since this deposition, a great erosion and destruction of the coal measures has taken place, and the most important subjects now to be determined are: Under which part of the New Red Sandstone that now overlies the coal measures do workable coals still remain? How thick is the New Red covering in those parts? Do Permian rocks occur between the New Red and the coal measures? These are points which can only be answered by those who possess an accurate knowledge of theoretical and practical geology. Professor Jukes states distinctly, that any one intending to try for coal beneath the Red Rocks, must be prepared to sink boldly one thousand yards before there is any hope of meeting with the coal measures. There is then, a chance, and a chance only, that the adventurer may find good workable coal beneath him. But there is also a chance of his finding the coal measures destitute of valuable workable coal; or of his not finding the coal measures at all, but, in consequence of their

removal by denudation and erosion, coming down upon some of the Lower Palæozoic rocks.

As such hazardous speculation would be beyond the sphere of private enterprise, Professor Jukes thinks that the explorations ought to be made at the national expense.

In his inaugural address to the chemical section Professor Miller recounted the chemical discoveries and progress of the past year, and alluded to many new applications of the science to the useful arts, particularly to the improved methods in the voltaic deposition of metals. He stated that Weil had, by the use of a solution of tartrate of copper, coated steel and iron with a tough closely-adherent sheathing of the metal, by simply suspending the articles to be coated in the copper solution, by means of a wire of zinc, no battery being required; and that lead and tin may be also deposited on iron or copper in a similar manner, provided the oxides of those metals be dissolved in a strong solution of caustic soda.

Professor Miller described the singular experiments of Deville and Froost, proving the permeability of metals to gases at high temperatures. Thus platinum and iron when white hot are perfectly porous and readily permeated by hydrogen, but recover their usual character as they cool. This passage of hydrogen will take place at a white heat through a tube, the thickness of which is one-sixth of an inch. These discoveries have an immediate practical bearing, as they prove that air pyrometers constructed of metal are not to be relied on. Glazed porcelain, however, is not open to the same objection, as it appears perfectly impervious to gases at all temperatures to which it has been exposed.

Sir Henry Rawlinson delivered the inaugural address in the Geographical Section, and recounted the important geographical events of the past year, which have been recorded in the pages of the INTELLECTUAL OBSERVER.

Sir Henry Rawlinson mentioned that Mr. Greenhow, an American merchant, had fitted out an expedition, headed by Capt. Hall, to proceed in search of the remains of the Franklin expedition. Capt. Hall is at present on the track of Franklin, and, it is to be hoped, will discover any further remains that may exist of that ill-fated exploration.

In the department of Statistics and Political Economy the address was read by Lord Stanley, and in that of Mechanical Science by Sir W. Armstrong, the main topics of his speech being the mode of action of Giffard's injector, which has already been described in the INTELLECTUAL OBSERVER; the advantages of Siemen's regenerative furnace, and of Bessemer's process for making cast-steel. In our next we shall give abstracts of such of the more important discoveries brought forward in the different sections as have not been hitherto described in our pages.

NOTES AND MEMORANDA.

NOTE ON SATURN'S RINGS, BY MR. PROCTOR.—We have received the following from Mr. Richard Proctor:—"It is certainly not absolutely impossible that in some parts of the universe vapours may have a density greater than that of water—that is to say, some hundreds of times greater than that of the densest terrestrial vapours. By admitting the possible existence of such vapours near Saturn, we widen the field of speculation as to the nature of Saturn's rings; and if we further assume that the rings are not under the dominion of gravity, there is a still 'wider field for the admission of dissimilar theories.' The only positive (but far from conclusive) evidence I know of against the former view, is the circumstance (proved by spectrum analysis) that Saturn's globe and rings are surrounded by an atmosphere whose constitution is very similar to that of our own atmosphere.* That terrestrial cloud reflects and intercepts light hardly proves that vaporous rings would do so; since cloud is not vapour, but formed by the condensation of aqueous vapour into minute, opaque, and (for the most part) hollow spherules of water. However, if we concede the possible existence of vapours of the density mentioned above, we may readily concede to them the power of reflecting or intercepting light. Your remarks on the dark ring remind me of a circumstance I had omitted to consider. Even if the reflective powers of a satellite and its primary were equal, the former would appear as a dusky spot in transiting the central parts of the latter's disc. For, by two well-known optical properties, the apparent illumination of any point of the disc of a satellite is equal to the real illumination, which varies as the cosine of the angle of incidence of the illuminating rays. Hence it may readily be shown that the mean illumination of the disc : the illumination of the centre of the disc (:: the content of a sphere : the content of its circumscribing cylinder)† :: 2 : 3. I may notice that, if the illumination of the dark ring could be determined, it would be very easy (assuming the truth of the satellite theory) to determine approximately the illumination of the part which crosses the ball. For instance, call the illumination of the central parts of the disc of Saturn, or of a satellite, 1; assume the illumination of the dark ring to be $\frac{1}{2}$, and, for simplicity, that there is no overlapping of the discs of satellites: required to compare the illumination of three small equal spaces—of the dark ring, of the dusky band across the ball (central part), and of the central part of Saturn's disc. Call these spaces respectively A, B, and C. The illumination of A, $\frac{1}{2}$, would be increased in the proportion of 3 to 2 if the whole disc of each satellite were as bright as the central part of the disc, or would be $\frac{3}{10}$. Thus the discs of satellites cover $\frac{3}{10}$ths of space A; and therefore of space B; and, further, $\frac{3}{10}$ths of the background of space B are in shadow, so that the mean illumination of the spotted background is $\frac{7}{10}$. Since $\frac{7}{10}$ths of this background, so illuminated, are visible, the light received from this part of space B is $\frac{49}{100}$; and since the discs of satellites occupy the remaining $\frac{7}{10}$ths of space B, and give the mean illumination $\frac{3}{10}$, the light received from this part of space B is $\frac{9}{100}$, or $\frac{30}{100}$; hence the total amount of light from space B is $\frac{69}{100}$. Thus the illumination of A : the illumination of B : the illumination of C :: $\frac{1}{2}$: $\frac{69}{100}$: 1, or :: 20 : 69 : 100. By assuming different values for the illumination of the dark ring these proportions can be varied. It may be noticed that, if we assume the illumination of A to be $\frac{1}{3}$, we obtain for the illumination of B its least possible value—viz., $\frac{2}{3}$."

84TH PLANET.—Dr. R. Luther, of Bilk, discovered a new planet on the 25th of August. Its mean position for 1865 is given by him in *Astronomische Nachrichten*, R.A. 324° 29′ 34″·4. S.D. 14° 17′ 49″·4. It is the size of a 10th magnitude star, and has been named Clio.

A FUNGUS IN IVORY AND BONE.—Professor Wedl found, on examining some sections of teeth that had been macerated for a few days in water, that they were

* *Philosophical Transactions*, 1864, p. 423.

† The parenthesis is introduced as suggesting a simple geometrical proof of the proportion in question.

attacked by fungus cells resembling mushroom spores. They perforate the cement and the ivory, but not the enamel. They live at the expense of the organic matter of the teeth, which they do not attack till after death. Their action is noticed in fossil teeth. Eberth and Kölliker appear to have previously made similar observations.—*Archives des Sciences. Sibzungsher der Wiener akad.*

The Dry Fog of July, 1863.—In 1783 a dry fog covered the greater part of Europe, and was considered one of the effects of the great volcanic eruption of that year. The dry fog of July, 1863, was specially noticed in Switzerland. On the 14th it began in the morning at Morges, and increased during the day. The mountains of Savoy could scarcely be seen, and at half-past six the sun scarcely projected any shadow, and none at 7·15. At night only large zenith stars could be distinguished. These effects lasted for several days, gradually diminishing. The Italian volcanoes were in action at the time.—*Archives des Sciences.*

The Growth of the Mistletoe.—M. Joseph Boehm states as the result of examinations and experiments, that "the mistletoe has precisely the same relation to its nutritive plant as a twig to its parent branch, or a graft to the stock.—*Bericht der Akad der Wiss in Wien. Annals of Natural History.*

Reasonable Conduct of a Spider.—M. Barthet states in *Cosmos* that he saw at Malta a scorpion caught in a spider's net. The spider immediately attacked the scorpion, but on discovering the character of his opponent, retreated hastily, and reappeared *under* his net, through which he could safely renew the combat. M. Barthet returned to the place a few days later, and found the scorpion dead and the spider disappeared.

Active Principle of Calabar Bean.—Dr. Vee obtains from the bean an alkaloid which he calls *eserine*, "eser" being the native name of the bean. He macerates the bean in alcohol, evaporates the fluid, rubs up the residue with a little tartaric acid, which he removes with water, supersaturates the solution with bicarbonate of potash, agitates with ether, which takes up the eserine, and deposits it on evaporation. Re-dissolved in ether, and allowed to evaporate spontaneously, it forms rhombic lamellar crystals. A dilute solution of eserine exhibits the poisonous properties of the Calabar bean. A student tried the effects of this substance on his own person. About half-past nine in the morning he took one centigramme of eserine in solution (about 3-20ths of a grain). It had no immediate effect, but as he was walking across the Place de la Concorde he felt a great heaviness in his head. He read as he walked, but soon lost power of distinguishing the letters, suffered from nausea and extreme weakness, without fever. With difficulty he reached the Tuileries gardens, having frequently to take hold of the trees, on account of the state of his sight. About half-past ten he had an attack of vomiting, after which he was able to sit down on a bench. He could not distinguish persons who passed him, but he saw the colours of objects at a greater distance. This condition lasted till half-past eleven, and it was not till an hour later that he was able to reach home, when he looked at himself in a glass, and found the pupils of his eyes scarcely perceptible. By one o'clock all the symptoms of poisoning disappeared.—*Cosmos.*

Preserving Elms from Insects.—M. Eugene Robert, being directed by the local administration to stop if possible the ravages of the *Scolytus destructor* amongst the elms of the Boulevard d'Enfer, had the old bark lightly planed, and then caused the fresh surface to be impregnated with strong spirits of camphor rubbed in with a brush. M. Camille Schnaiter, writing in *Cosmos*, states that the insects have disappeared.

A Fossil Engraving.—M. Lartet describes to the French Academy a plate of ivory dug up in Perigord, and having engraved upon it the head of a long-haired elephant.

Ancient Sculpture on Reindeer Horn.—M. de Vibraye has a paper in *Comptes Rendus* on some sculptured ivory and bone dug up at Augerie, on the right bank of the river Vézères, Dordogne, and especially describing the figure of an elephant's head carved in reindeer horn. The details do not coincide with

the existing species of elephant, but correspond with those of the mammoth. Taken in connection with the analogous discovery of M. Lartet, M. Vibraye thinks that no doubt can now exist that the men who sculptured these figures were contemporaneous with the mammoth.

Development of Striated Muscular Fibre.—Dr. Wilson Fox has a paper in the *Proceedings of the Royal Society*, in which he states that "the earliest form in which muscular tissue appears in the tadpole is an oval body containing one or more nuclei, and densely filled with pigmentary matter. This body has a well-defined outline, which induces the author to regard it as a cell, though he has not succeeded in isolating any distinct membrane. Such bodies increase in length with or without multiplication of their nuclei, and after a short period a portion of their structure loses in great part its pigment, and exhibits a striation sometimes transverse, sometimes longitudinal, or occasionally both conjointly, but there is no distinct line of demarcation at this stage between the striated and non-striated portion of the cell contents, showing that the change takes place within the contents of the cell."

The Size of Star Discs.—It is a very general opinion amongst telescopists that Mr. Dawes spoke without due caution and limitation in affirming at the Astronomical Society that the size of star discs depended upon the aperture of a telescope *only*; and that Mr. Pritchard was over hasty in declaring his accordance with an opinion that absolutely denies the effect of aberrations, chromatic and spherical, in making the spurious discs look larger than in well-corrected instruments. Steinheil has noticed Mr. Dawes' contradiction of his statement that the focal length of an object-glass directly affected the size of the discs, the latter being smaller as the focal length assigned to any given aperture was diminished. In the *Astronomische Nachrichten*, Steinheil accepts this correction, and he explains the fact that his Leipzig 8-inch telescope does not separate stars which other instruments of the same size will divide, by ascribing it to the superior light of his own instrument. By augmenting the apparent brightness of a star, he says its disc is increased, and may be diminished by lessening its brilliance. Some of our readers who have large telescopes will be able to test this theory by adopting various modes of lessening the light. The late Admiral Smyth, acting, we believe, on a suggestion of Sir John Herschel, occasionally stopped out a portion of the centre of his object-glass. Mr. Knott of Woodcroft, Cuckfield, who has a very fine 7½ inch object-glass, and who is familiar with this plan, has just been kind enough at our request to make a special trial of its effect and let us know the result. He does not profess adhesion to Steinheil's theory, but on stopping out 2 inches in the centre of his object-glass he found that it cleared up the disks of that difficult object γ^2 Andromedæ, when powers of 360 to 791 gave a beautiful vision of two unequal disks crushed together with a dusky streak across the base of junction.

To Distinguish Linen from Cotton.—*Cosmos* states that Professor Böttger asserts that the mixture of cotton with linen may be detected by unravelling a piece of the tissue, both warp and weft, and plunging it into a weak solution of aniline and fuchsine. It should be taken out, and washed with plenty of water, and while moist, dipped in water containing a little ammonia, when the cotton threads will lose their colour, while the linen will remain bright rose red.